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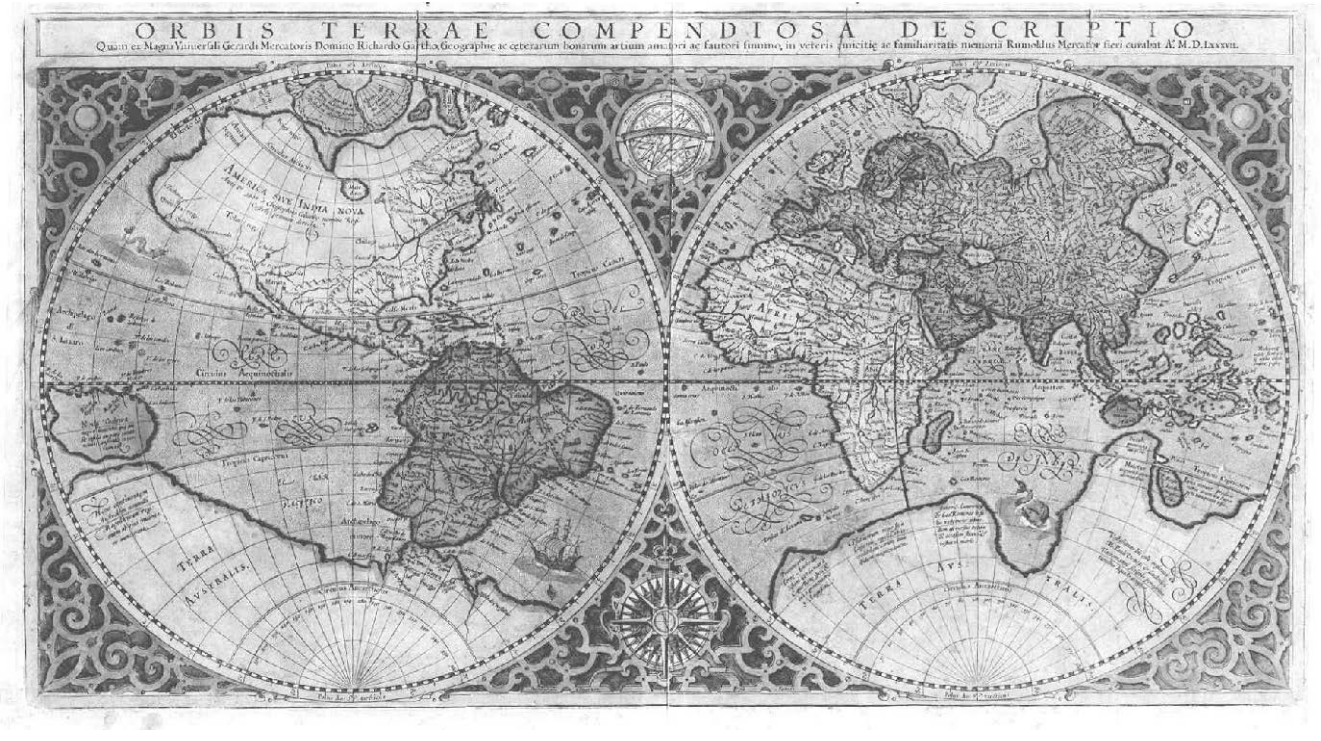

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SECTION I
NAVIGATION AND MARITIME TRANSPORT

CORRELATION BETWEEN HUMAN FACTOR AND SHIP STABILITY

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ABSTRACT

The present paper presents general and particular aspects regarding the impact of human factor on the safety of ships and safety of navigation. The correlation between safety of ship stability and the influence of human factor is presented through real case accidents. Methods of evaluation of human factor upon ship stability are pointed out. The role of human factor from the ship's stability point of view is clearly identified in relation to critical hazard.

Keywords: *human factor, safety, navigation, stability.*

1. INTRODUCTION

Since first man went to sea, the human error has been blamed as the cause of accidents. Current wisdom is that human error, attributable to the Master and /or crew of a ship, has been responsible for approximately 80% of maritime accidents, at least in part [1].

Over the last 25 years or so, the main target of shipping industry was to improve the reliability of the ship system as well as the ship structure in order to minimize accidents and increase efficiency and economy. The ship systems became technologically advanced and highly reliable due to important improvements that have been made in hull designs, propulsion system and navigational equipments.

With a growing awareness of safety issues, public tolerance of accidents in shipping has decreased. So even nowadays, despite all of the improvements and advanced technologies, maritime casualties continued to happen, moreover with a high rate. This happen as a result of the fact that ship system reliability and ship structure are only a small component of the safety system. As people are the most important part of the maritime system then the human errors are predominant in casualty situations.

Human error is often described as being an incorrect decision, an improperly performed action, or an improper lack of action]. In considering the human contribution to marine accidents, it is most important to analyze two types of errors: active errors, when the effect occur immediately and latent errors whose adverse effects may lie within the system for a long time [2].

Active errors are categorized when the actions of the ship's crew leading up the time of the incident. Latent errors are categorized that are occurring at an earlier stage of the ship's building process or in other conditions at different levels of management decisions.

The new developments in ship design and navigation equipment have considerably reduced the rate as well as the grade of severity of shipping incidents. However, the reduction of failures in technology has revealed the underlying level of influence of human error in accident causation [3].

2. CASUALTIES OF SHIP STABILITY FAILURE RELATED TO HUMAN ERROR

TORM ALEXANDRIA – 270 TEU feeder containership

The vessel was under loading and in the same time discharging operations of containers at the port of Monrovia, Liberia. While lifting a container from the berth with the ship's crane, a suddenly heeling of the vessel ot portside was developed. Then, the master attempted to control the list using the ballast but without the desired effect and the vessel continued to list further until she capsized (Fig. 1).

Figure 1 Feeder vessel "Torm Alexandria" capsized alongside berth [4]

The subsequent official enquiry revealed that the main cause of ship's capsize was the attempted lift of a heavy container from the berth at a time when ship's stability was very small or even zero. The ship developed a sudden large angle of heel as a result of suspension the heavy container in ship's crane. This aspect brought the vessel in a situation that the developed angle of heel was beyond all positive values of righting levers. Nothing could be done to remedy the situation as was also exacerbated by the shifting of containers across the deck and sea water flooding the engine room through an open trap hatch on main deck.[4]

The vessel's unstable condition and her subsequent capsize was a result of the following factors:

- The ship's staff not paid the importance of preparing the curve of righting levers for the vessel's actual loading condition.
- Vessel's officers were too much confident in respect of the fact that for the vessel's transversal stability in all conditions of loading, only the initial metacentric height (GM) represents a criterion.
- When the GM of the vessel was calculated, no allowance for free surface effect was made, despite that clearly instructions were stated in the stability booklet in this respect.
- Despite the fact that a written letter issued by the owners stated that only 740 tons of cargo has to be loaded on deck, corresponding with loading condition no.7 from ship's stability booklet, no attention was paid for this issue. At the time of the incident, a quantity of 1150 tonnes were actually loaded on deck that means with 55% in excess. That means the limit for the cargo on deck was breached only by the weight of the first tier of containers loaded on deck.

COUGAR ACE – 55,328 GRT Car Carrier

After the vessel departed from Yokohama port, loaded with 4,703 cars, Chief Officer planned the ballast exchange. Vessel's Master advised Chief Officer to conduct the ballast exchange in one pair of tanks at the time. Chief Officer informed him that in the worst case scenario, if four tanks were to be deballasted together till they were emptied, the vessel's GM would be 0.50 m positive. In the next four days, the deballasting and ballasting operations went as planed by Chief Officer. However, during this period of time, a couple of tanks, that were not planed for deballast operations as per ballast water exchange plan drawn by Chief Officer, were deballasted in order to correct the vessel's list in the same time with the planned ballast tanks. On 24th July, during ballast exchange process, the vessel started to list to port and within few minutes was lying on its portside about 80° list (Figure 2).

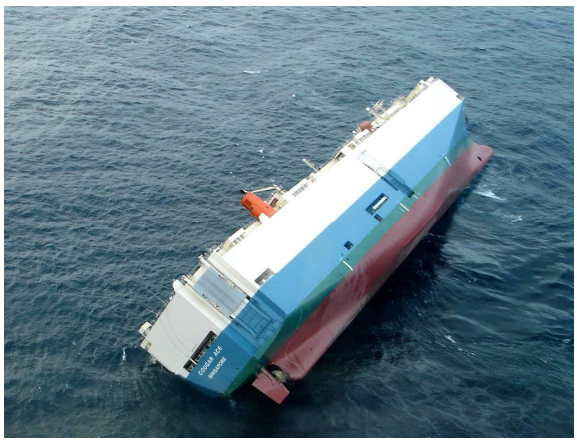

Figure 2 MV Cougar Ace lying on its portside [5]

As per investigation report, the sequential exchange of water ballast would result in the ship having four of its nine water ballast tanks empty. [5] [6]

This aspect, together with additional water ballast being pumped out for the adjustment of list, and correlated with the consumption of fuel from double bottom tanks, resulted in the ship becoming unstable and developing an angle of loll to port side of about 80°.

There were some important inadequacies in the ship's ballast water exchange operation that came out from the investigation report [5] [6]:

- Improper planning and execution of ballast water exchange operations. This fact resulted in insufficient weights in the water ballast tanks below the ship's waterline;
- Ship's staff in charge with the ballast exchange operations, i.e. Chief Officer and Master, failed to ensure that the ship stability is maintained throughout the operations, at various stages of ballast water exchange;
- Failure of Chief Officer and Master as to clearly understood and complied with the IMO recommendations related to safe operations of the ballast water exchange procedure .

GULIZAR ANA – 1,500 GRT, general cargo vessel

Vessel was in ballast voyage from Turkey to Romania, one port on Danube River, for loading steel coils. Before entering the river, vessel de-ballasted all ballast tanks, double bottom and side tanks as well as the fore peak tank. During loading of the 5th steel coil, vessel began to lean on starboard side till the vessel's accommodation has propped on main deck of the floating crane berthed alongside vessel. The list of the vessel was 51 degrees (Figure 3). Engine room and starboard side crew quarter have been flooded.

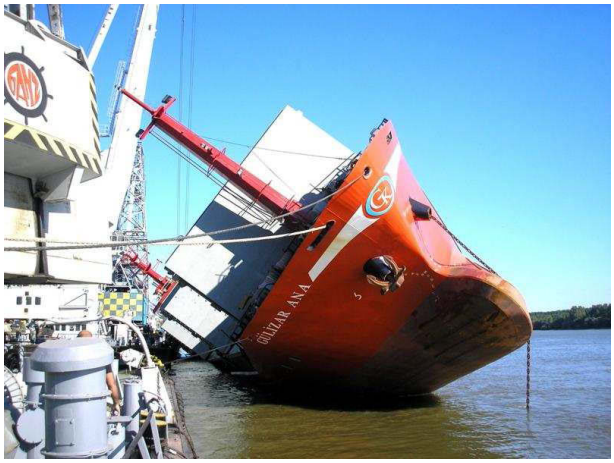

Figure 3 Vessel "Gulizar Ana" listed at starboard side, alongside berth [7]

Notwithstanding the list was a result of shifting of coils inside the hold, the main cause of the accident was that the vessel, after de-ballasting all ballast tanks, remained with insufficient weight below waterline thus leading to insufficient stability of ship. This fact was the result of improper planning of de-ballasting and failure of ship's staff to maintain the ship stability [7].

3. HUMAN FACTOR AND SAFETY OF SHIP

A classical field of ship safety and safety to navigation is without any doubt the intact stability of the vessel. In regard to the ship safety, the intact stability is of paramount concern. The earliest regulatory recognition of this can be traced to before Samuel Plimsoll in the 1860's. Times have moved on and stability regulations have come on a long way but the concern remains high.

Vessel's intact stability is a fundamental component of seaworthiness so it is in the interest of all owners/operators to learn about this topic and ensure that their vessel possesses a satisfactory level of stability in order to ensure its safety as well as that of the people on board the ship. Understanding ship's stability, trim, stress, and the basics of ship's construction is a key to keeping a ship seaworthy.

Human factor is also a contributory factor to safety of ship. A Master's error in applying proper decisions may result in a failure of equal consequences so that of bad design. An incompetent ship's officer can easily make a fine, seagoing ship unseaworthy, but even the most experienced, prudent and vigilant officer cannot turn a badly designed, unseaworthy ship into a safe one.[8]

Man can be looked upon as apart of the total system and, as with any other physical system, a human being may suffer weakness or fail altogether. This is of great importance when man controls other systems in combination: for example master/ship or pilot/aircraft systems.

The overlap between these basic factors contributing to ship safety in a seaway is schematically shown in Figure 4.

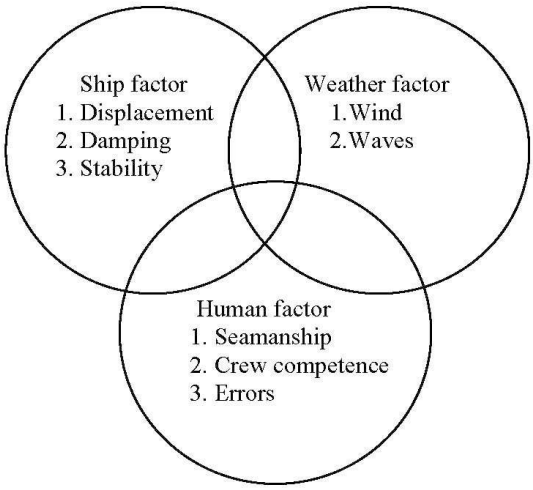

Figure 4 Overlap between factors contributing to safety of ship

Following the logic of Figure 4, the problems of safety of ship stability are discussed from three different aspects:

1. Fundamental design features which determine a ship's behavior in extreme weather conditions and her seaworthiness in terms of intact ship stability failure. Although there seem to be a large number of different ship stability failure situations with different mechanisms involved, their number can be reduced to a few basic modes.
2. The dynamic aspects of wind and wave forces, particularly relevant to capsize situation.
3. Human decisions. Good seamanship in heavy weather is not a quality which can be learned from reading books alone. It is, however, reasonable to expect that a man who learns much from his own experience can also gain a little from the experience of others, or from knowledge acquired through scientific experiments. This may help him to make rational decisions regarding seakeeping strategy in particular sea conditions.

A human-ship system is a technical system which is operated by people. The activity of human-ship system is in strong connection with a various categories of problems like operational, technological, human, etc. Human problem is the most important part in consideration with safety of ships.

In ship safety, the influence of human factor is in connection with:

- Human resources – recruiting, teaching, training.
- Career – qualifications, motivations, experience.
- Performance on board ships – adaptation, assimilation.

4. METHODS OF EVALUATION OF HUMAN FACTOR UPON SHIP STABILITY

The human influence upon the ship stability is manifested by the ignorance of information referring to the ship stability, the lack of general marine knowledge, wrong maneuvering during unfavorable weather. The stability casualties resulted mainly from the wrong operation of ship by man.

The influence of human factor upon ship stability can be evaluated by two possible methods: computer simulation tests and full scale investigations.

In our day, when ships are very modern, the man takes the role of a controller-observer. On board vessel the man is connected with receiving, transforming, sending and utilizing information being in the position for fulfilling a variety of functions. In order to accomplish the tasks on board vessel, the man's behavior is dependent on his knowledge, experience, ability, condition of ship, condition of loading, weather factors, etc.

One of the best method for determining the influence of human factor upon ship stability is the real-time simulation with the help of a simulator. Such a simulator enables improving the ship stability safety due to observation of the actual situation of cargo loaded, condition of loading, weather information or situation of the sea, ship behavior at various angles of heel, variations of stability parameters. Those information to be in a form of an image, numerical data, etc to give the possibility of taking a rapid and correct decision.

Fitness-for-duty and the personnel readiness represents assessments of the crew to safely and reliable perform their duties.

- Knowledge, skills and abilities that stem from an individuals basic knowledge and general training.
- Task specific maritime training and abilities (certification and licenses).

Placing a person in a position without the requisite skills, training, or tools will reduce safety, efficiency, and increase the potential for error. Often too much reliance is placed on a few highly skilled individuals in senior positions. Safety requires experience.

It is of paramount importance that stability (refresher) courses should be given at regular intervals for those working in the field (i.e. ship designers, crew, operators, managers etc.) [8].

The benefit of a highly trained and motivated workforce cannot be over stated. Such a crew is better able to deal with difficult situations when they arise and so prevent or mitigate incidents.

5. CONCLUSIONS

In the age of precision navigation and the satellite era, many casualties still occur at sea. Maritime transport safety is being enhanced by introducing numerous technical measures, by building safer ships, developing new and more efficient methods of transportation, investing in human resources, increasing traffic surveillance and control, issuing new regulations, etc. Nevertheless, accident statistics show that these measures are not sufficient and sometimes unable to halt shipping casualties. Casualties with catastrophic consequences still happen.

Stability of ship is a problem in which not only the inherent features of a ship but also the action of its crew determine weather the ship will survive in critical conditions. The correct reaction in dangerous situations and the skills of the crew may well decide between survival and disaster. The human factor should be taken into consideration in the overall analysis of safety against capsizing. [8]

Human factor still remains a decisive factor for the ship stability and safety at sea, despite the growing process of automation to ships. The ship stability casualties shows that human factor is one of the most important elements of the ship safety system. The loss of control over a ship, not only in a critical situation, can be a main cause of casualties. For the safety of ships the human factor and technical factor are equally important. However, the man is the decisive factor.

Human factor issues are therefore complex and need to be carefully analysed, but more importantly, recognized if there are to be any significant improvements in safety at sea. Quality factors, like human factors, are concepts that are frequently talked about but rarely if ever adequately addressed. Seafarers are locked into a system that is very dependent upon them. They are the most important quality factor throughout the life of a ship.

There is a need to adopt humane approach to what is a very human issue. Concentration on satisfying narrow rules of ship construction and operational training is not enough. The ISM Code, while useful, fails to address the issues relating to human factors.

New insights, like concerns of the influence and contribution of the human element to ship stability casualties, have to motivate maritime community, Class societies,, to broaden their role in safety of ship stability in significant ways.

The changing attitude for the connection between stability of ships and human factor is well reflected in the work of the international research community, in particular at IMO. In the Code of Intact Stability of Ships, the stability requirements and standards have been supplemented by some paragraphs related to human factor in operational aspects of stability safety, as for instance: "*Compliance with the stability criteria does not ensure immunity against capsizing regardless of the circumstances, or absolve the master from his responsibilities. Masters should therefore exercise prudence and good seamanship having regards to the season of the year, weather forecasts and the navigational zone, and should take the appropriate action as to speed and course warranted by the prevailing circumstances [9]*."

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AN OVERVIEW UPON CO_2 – POSSIBLE SOURCE OF OCEAN ACIDIFICATION

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ABSTRACT

The interest upon CO_2 concentrations introduced in the atmosphere by human activities enhances year after year because of the consequences on the atmosphere, land and oceans. Many studies showed that changes in the ocean carbon cycle are due to the absorption of anthropogenic CO_2 from the atmosphere. The increase of CO_2 has been correlated with the pH falling of seawaters, promoting a critical process known as acidification. Ocean acidification could modify many biochemical cycles and functioning of marine organisms.

The aim of this paper is to demonstrate the chemistry behaviour of CO_2 on seawaters. Once dissolved in seawater, CO_2 reacts with water to form carbonic acid (H_2CO_3). Ocean stores CO_2 as dissolved inorganic carbon (DIC) which remains in the form of dissolved CO_2 and H_2CO_3, while the rest is in the form of HCO_3^- and CO_3^{2-}. Adding CO_2 to seawater, thus increase HCO_3^- that bring about a decrease in ocean water pH by increasing H^+ concentration.

Keywords: *CO_2, absorption, ocean acidification, chemistry.*

1. INTRODUCTION

Human activities such as burning of fossil fuels and industrialization have resulted in rising atmospheric CO_2 concentration. Emission of CO_2 caused increasing concentration of CO_2 in the atmosphere and this is one of the major drivers of global warming as well as seawater carbonate chemistry.

The climate deal adopted during the Climate conference in Paris in 2015 (COP 21) clearly specifies the need for global emissions including CO_2 to peak as soon as possible. This will help governments to attain a long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels. Achieving emissions cuts below 1990 levels by 2050 requires a process of "decarbonising" the economy. For this to materialise new and innovative low-carbon technologies will have to be developed and deployed. [32]

Oceans play a very important role in the global carbon cycle and Earth's climate system [9]. The absorption of anthropogenic CO_2 from the atmosphere by ocean physics and biology has already led to substantial changes in the ocean carbon cycle, with potentially larger changes looming ahead [27, 29]. Oceans act as a deposit for CO_2 and there is a flux of CO_2 across the interface between the atmosphere and ocean surface.

Absorption of CO_2 by the ocean is an essential buffering process of seawater, however, it also alters the chemistry of the seawater at a fundamental level. Increase of CO_2 in the ocean and a decline in ocean pH, thus, promoting one of the most critical events known as ocean acidification (OA) [26].

The average ocean surface water pH has fallen by approximately 0.1 unit over about the past 200 years [26] and is expected to decrease a further 0.3 - 0.4 unit if atmospheric CO_2 concentrations reach 800 ppmv [24] against the present concentration of 397 ppmv.

Maintenance of appropriate carbonate ion saturation is essential for the formation of calcium carbonate, which is the basic building block of exoskeletons and shells of a large number of marine organisms, including corals, shellfish, crustaceans and plankton [11, 17].
However, the consequences of ocean acidification also affect the marine microorganisms that are responsible for the net productivity of the ocean. These are key component of marine biogeochemical cycles which are involved in nutrient cycles, organic matter decomposition and carbon flow in the marine ecosystem [4, 6].

The aim of this paper is to highlight the influence of CO_2 on marine environment and its role in a number of other chemical interactions between ocean and atmosphere. Furthemore, the main objective of this paper is to demonstrate the chemistry behaviour of CO_2 on seawaters, which acts as a greenhouse with possible action of ocean acidification.

2. CO_2 INTERACTIONS BETWEEN ATMOSPHERE AND OCEAN

Cycling of carbon among the ocean, atmosphere and land is a fundamental component of the chemical perspective of oceanography because the fugacity (fCO2) or partial pressure (pCO_2) of carbon dioxide is the most important greenhouse gas in the atmosphere with multiple inferences on ocean acidification.

Since there is about 50 times as much inorganic carbon dissolved in the sea as there is CO_2 in the atmosphere, ocean carbonate chemistry has a great impact on fCO_2 in the atmosphere. On time scales of hundreds to a thousand years, the main marine processes that influence fCO_2 in the atmosphere are the thermodynamic temperature dependence of CO_2 solubility in seawater (the solubility pump), and the interplay between the rate of ocean circulation and the rate of biological carbon removal from the euphotic zone

to the deeper reservoirs of the ocean (the biological pump). On longer time scales, of the order of one to tens of thousands of years, the preservation and dissolution of calcium carbonate along with the rate of weathering and the transport of bicarbonate to the sea come more into play.[21]

Many researchers considered that the Earth is presently in the early stages of a grand acid - base titration of seawater by CO_2. Anthropogenic CO_2 is being added to the atmosphere at a rate fast enough to have resulted in an approximately 30% increase in the fCO_2 of the atmosphere since pre-industrial time. Only about 40% of the CO_2 added to the atmosphere has remained there: the rest has gone into the land and ocean carbon reservoirs. It is extremely important that we understand the processes controlling the uptake of CO_2 because future prediction of global climate will depend on knowing CO_2 partitions between the atmosphere, land, and ocean. The long-term response of the ocean's carbonate system to past climate perturbations, on time scales ranging from ten thousand to hundreds of millions of years, involves the interaction of the seawater carbonate system with the carbonate solids deposited in marine sediments. For example, there are very large changes in the calcium carbonate content of deep-sea sediment cores that span past glacial–interglacial times from all the ocean basins that tell us something about past excursions in the chemistry of the sea and atmosphere. Interpreting these records requires an understanding of the present-day relation between carbonate chemistry and $CaCO_3$ preservation in marine sediments.

The global carbon cycle involves reactions within and exchange among the major global reservoirs: atmosphere, ocean and land (Fig. 1). The important reactions are formation and destruction of organic matter and calcium carbonate via photosynthesis/respiration and precipitation/dissolution, respectively. Exchange among the reservoirs is primarily via CO_2 gas exchange, flow of dissolved inorganic carbon (DIC = HCO_3^- + CO_3^{2-} + CO_2) in rivers, and the mineral calcium carbonate, $CaCO_3$. HCO_3^- and CO_3^{2-} represent the anions of bicarbonate and carbonate, respectively [30].

The amount of carbon in each of the main global deposits and the exchange fluxes provides a qualitative impression of how much the reservoirs depend on one another (Figure 1).

Among the atmosphere, land and ocean, the carbon deposit size of the atmosphere is by far the smallest (600 Pg before anthropogenic changes, where 1 Pg = 10^{15} g); dissolved inorganic carbon (DIC) of the ocean the largest (38,000 Pg) and the exchangeable reservoirs in land plants and soils are somewhere in between (c.2,000 Pg). Since atmosphere–land and atmosphere–ocean CO_2 exchange rates are about the same (on the order of 100 Pg γ^{-1}), it is pretty clear that the pressure of CO_2 in the atmosphere is a slave to processes that occur in the larger reservoirs.

There are two categories of fluxes depicted in Fig. 1: ''long-term'' fluxes, indicated by dashed arrows, and ''short-term'' fluxes, indicated by solid arrows. The ''long-term'' fluxes represent fluxes associated with processes of weathering; the ''short-term'' fluxes are those that are driven primarily by photosynthesis and respiration.

Each of these mechanisms controls the fCO_2 in the atmosphere on different time scales [8, 20].

Changes in weathering reactions due to seafloor spreading and tectonics such as mountain building are believed to have been the major factors for regulating the CO_2 content of the atmosphere through the early history of the Earth on 10–100 million year time scales [7].

The present-day weathering fluxes depicted in Fig. 1 are normalized to the flux of DIC (9) (primarily bicarbonate anions, HCO_3^-) that enters the ocean via the world's rivers (c.0.4 Pg γ^{-1}).

The carbonate system of the ocean plays a key role in controlling the pressure of carbon dioxide in the atmosphere, which helps to regulate the temperature of the planet.

The formation rate of the most prevalent authigenic mineral in the environment, $CaCO_3$ is also the major sink for dissolved carbon in the long-term global carbon balance.

Dissolved compounds that make up the carbonate system in water (CO_2, HCO_3^- and CO_3^{2-}) are in chemical equilibrium on time scales longer than a few minutes.

Although this is less certain in the heterogeneous equilibrium between carbonate solids and dissolved constituents, to a first approximation $CaCO_3$ is found in marine sediments that are bathed by waters that are saturated or supersaturated thermodynamically and absent where waters are under saturated.

The flux of CO_2 out of the atmosphere (0.26 Pg γ^{-1}), that provides the acid for dissolution of rocks in soils via weathering and flows to the ocean as HCO_3^-, must be matched by an equal return flux to the atmosphere.

The studies showed that the absorption of CO_2 in the seawaters influenced their biodiversity by pH modification.

Humans are significantly increasing the atmospheric concentration of CO_2, and the oceans play an important role in modulating this increase.

The difference between organic carbon production by photosynthesis and respiration in the marine euphotic zone is about 10% of the rate of photosynthesis and equal to the transport of organic carbon to the ocean interior by sinking particulate material and mixing of dissolved organic carbon (DOC) [12].

The reactivity of CO_2 is represented by equations (1 – 3).

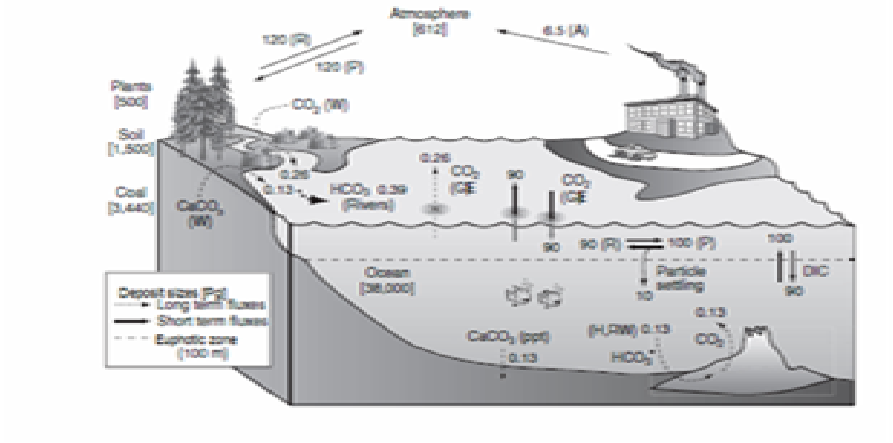

Figure 1 The global cycle of Carbon: dashed line - long term of Carbon cycle induced by weathering (W), solid arrows - shorter term of Carbon fluxes induced by photosynthesis and respiration, dotted line - euphotic zone [12].

This return flux derives partly from precipitation of $CaCO_3$ in the ocean (1), which is supported by the Ca^{2+} and HCO_3^- flow from rivers.

$$\underset{\text{Carbonate rocks}}{CaCO_3(s)} + CO_2 + H_2O \underset{\text{dissolution}}{\rightleftarrows} 2\,HCO_3^- + Ca^{2+} \quad (1)$$

The other contribution to the return of CO_2 to the atmosphere is via a reaction to form silicate rocks that is the equivalent of reverse weathering (2):

$$10KAlSi_3O_8 + 5H_2O + 10H_2CO_3 \rightarrow 5Al_2Si_2O_5(OH)_4 + 20SiO_2 + 10KHCO_3 \quad (2),$$

where $KAlSi_3O_8$ represents a silicate, assigned as feldspat (from rocks) and $Al_2Si_2O_5(OH)_4$ represents the kaolin clay.

The larger ‘‘short-term’’ fluxes are mainly controlled by the processes of photosynthesis and respiration. In the case of the atmosphere–land exchange CO_2 is taken up directly from the atmosphere by photosynthesis in leaves and released from the plants and soils to the atmosphere via respiration.

This complex process can be summarized by (3):

$$nCO_2 + nH_2O \xrightarrow{\text{visible light}} nO_2 + (CH_2O)n \quad (3)$$

where (CH_2O) represents a general carbohydrate. The reverse of this process, the absorption of O_2 leading to the release of CO_2, is known as respiration. Different species preferentially absorb different wave lengths of visible light during photosynthesis, and have maximal growth at different temperatures [25].

Fluxes and deposits in Fig. 1 are those believed to be representative of pre-industrial values. Comparison of these values with the rate of input of CO_2 to the atmosphere via fossil fuel burning and cement production (c.6.2 Pg γ^{-1}) places the anthropogenic input into perspective with natural processes. The anthropogenic perturbation is about 20 times smaller than the one-way exchange of CO_2 between the atmosphere and ocean and the rates of photosynthesis on land or in the ocean, but about 20 times larger than the fluxes of CO_2 from global weathering and about half the present biological carbon pump to the deep ocean [7].

3 OCEAN CARBONATE CHEMISTRY

In water, inorganic carbon exists in four distinct forms; the gas in solution or aqueous carbon dioxide, CO_2 (aq), and the three products of hydration reactions, which are carbonic acid (H_2CO_3), bicarbonate (HCO_3^-) and carbonate (CO_2^-). Chemical equilibria among these species in seawater are described by the apparent constants, which have units necessary to make the dimensions of the equilibrium expressions correct:

$$H_2CO_3 \rightleftarrows CO_2(aq) + H_2O \qquad K'_{CO_2(aq)} = \frac{[CO_2](aq)}{[H_2CO_3]} \quad (4)$$

$$H_2CO_3 \rightleftarrows HCO_3^- + H^+ \qquad K'_{H_2CO_3} = \frac{[HCO_3^-] \times [H^+]}{[H_2CO_3]} \quad (5)$$

$$HCO_3^- \rightleftarrows CO_3^{2-} + H^+ \qquad K'_2 = \frac{[CO_3^{2-}] \times [H^+]}{[HCO_3^-]} \quad (6)$$

where the equilibrium constant, K_2' indicates the second dissociation constant of carbonic acid. Because only a few tenths of one percent of the neutral dissolved carbon dioxide species exists as H_2CO_3 at equilibrium, and because it is difficult to analytically distinguish between CO_2 (aq) and H_2CO_3, these neutral species are usually combined and represented with either the symbol $[CO_2]$ or H_2CO_3.

Equations (4) and (5) can be combined to eliminate $[H_2CO_3]$ and give a new composite first dissociation constant of CO_2 in seawater. If one assumes that

$[CO_2(aq)] = [CO_2]$, the first dissociation constant of carbonic acic, K_1' is:

$$CO_2 + H_2O \rightleftarrows HCO_3^- + H^+ \qquad K_1' = \frac{[HCO_3^-][H^+]}{[CO_2]} \simeq \frac{K'_{H_2CO_3}}{K'_{CO_2(aq)}}. \tag{7}$$

As shown in (7), bicarbonate and calcium ions together participate during the process of calcification. For the formation of calcium carbonate in biological materials, HCO_3^- is required; therefore, it is the challenge of overcoming enhanced dissolution (due to the decreased CO_3^{2-} level) for calcifying organisms.

The decrease in CO_3^{2-} concentrations will affect calcium carbonate saturation (K_2'), i.e. ratio of the ion activity product to the stoichiometric solubility product (6). If saturation is equal to unity, then solid and solution are in a state of equilibrium. If $K_2' < 1$, then dissolution of calcium carbonate can occur because of under-saturation and $K_2' > 1$ facilitates precipitation of calcium carbonate (a supersaturated state).

At equilibrium the gaseous CO_2 in the atmosphere, expressed in terms of the fugacity, f^a_{CO2} (in atmospheres, atm), is related to the aqueous CO_2 in seawater, $[CO_2]$ (mol kg^{-1}) [25]

$$K_{H,CO_2} = \frac{[CO_2]}{f^a_{CO_2}}. \tag{8}$$

The DIC of a seawater sample is the sum of the concentrations of the dissolved inorganic carbon species:

$$DIC = [HCO_3^-] + [CO_3^{2-}] + [CO_2]. \tag{9}$$

A positive correlation between saturated state and calcium carbonate production rate has also been reported in warm water corals [14, 15]. Calcium carbonate has two common polymorphs states: calcite and aragonite. The solubility of aragonite is higher than calcite. As a result, calciforms which produce aragonite are more susceptible to ocean acidification or calcium carbonate saturation [23, 31, 28]. As the calciforms are more subjected to changes in carbonate chemistry, but fluctuation in ocean of carbonate chemistry and calcifying organism community structure will affect the overall marine ecosystem.

Looking at the ocean carbonate cycle, significant effects on calcifying organisms and phytoplankton are expected [13] and the changes will certainly affect the ocean productivity and the carbonate chemistry [16, 18]. On marine organisms, ocean acidification has effects as biogeochemical cycle and ecosystems, which is supported by a large number of studies [1, 19].

As prooved in the reactions (1 -9), the ocean may have been, for several thousand years, precipitating more calcium carbonate than is supplied by the rivers, and thereby decreasing the total alkalinity of the ocean and releasing CO_2 into the atmosphere.

As the ocean becomes more acid, due to the discharge of anthropogenic CO_2, the loss of calcium carbonate from the ocean will likely decrease, and might reverse, increasing the total alkalinity of the ocean. In addition, eventually increasing CO_2 deep in the ocean will increase the dissolution of calcium in the sediments there, and cause the CCD (the calcite compensation depth) to rise, and will also increase the alkalinity of the ocean [22].

Increasing alkalinity increases the ability of the ocean to take up CO_2 (in effect it increases the uptake factor), but since the turnover time of the deep water is close to 1000 years, it will take a long time for the dissolution of calcium carbonate at depth to have much effect on atmospheric CO_2. Besides, it appears likely that humans will have burned up most of the available fossil fuel long before this effect becomes significant. Really, if the total fossil-fuel resources of the world are near 3500 Gt [22, 33], and humans manage to limit their consumption and release rate to not more than 10 Gt per year, the fossil-fuel reserves of the world will be effectively exhausted in 350 years, much less than the time needed for one recycling of the deep water of the world ocean. Eventually, over several thousand years, the dissolution of $CaCO_3$ on the sea floor will remove some of the excess CO_2 in the atmosphere.

According statistics, over several thousand years, the dissolution of $CaCO_3$ on the sea floor will remove some of the excess CO_2 in the atmosphere. Over several hundred thousand years, increased weathering of silicate rocks will neutralize much of the remaining excess CO_2 [3, 2].

4. CONCLUSIONS

A series of chemical reactions control seawater carbonate chemistry. The ocean acts as a receiver of CO_2 and once dissolved in seawater, CO_2 reacts with water to form carbonic acid (H_2CO_3). Nevertheless, ocean stores CO_2 as dissolved inorganic carbon (DIC) which remains in the form of dissolved CO_2 and H_2CO_3, while the rest is in the form of HCO_3^- and CO_3^{2-}. Adding CO_2 to seawater, thus increase HCO_3^- that bring about a decrease in ocean water pH by increasing H^+ concentration.

Changing CO_2 will affect numerous aspects of seawater chemistry. Ocean acidification could modify many biochemical cycles and functioning of marine organisms. Hence, with an increase in the atmospheric level of CO_2, there will be a successive increase in the concentration of CO_2 in the surface oceans. Carbon dioxide in the seawater takes part in several biological and geological reactions, but this gas is chemically very much inactive in atmosphere.

The models used to simulate the spatial distribution of the CO_2 ocean response show that the strongest increase of oceanic CO_2 sinks in response to higher atmospheric CO_2 are the North Atlantic and the Southern Oceans.

The associated chemistry response to a given change in CO_2 concentration is known with *very high confidence* [32]. According to model results, "it is virtually certain that the increased storage of carbon by the ocean will increase acidification in the future, continuing the observed trends of the past decades" [10].

Regional ocean carbon cycle models project that some nearshore systems are also highly vulnerable to future pH decrease. For example in the North Western European shelf seas, large spatial-temporal variability is enhanced by local effects from river input and organic matter degradation, increasing acidification from anthropogenic CO_2 invasion [5].

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TEAM AND SAFETY CULTURE ON BOARD SHIP. OBSTACLES FOR ACHIEVING A GOOD TEAM WATCH

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ABSTRACT

On board ships, bridge and engine teams have little time to forge until to become fully operational. Consequently the officers and ratings that are composing these teams should possess some good communication skills in order to make possible creation of efficient teams is such a short time. In most of the cases the good communication depends also on the level of English language proficiency of the seafarers. The scope of this paper is to reveal some of the possible on board obstacles that can impede the good work inside bridge or engine teams.

Keywords: *Team, Bridge, Communication, Crew.*

1. INTRODUCTION

With all the efforts of the shipping companies and authorities involved in the maritime transport in terms of safety, the ship accidents still occur and their number did not dropped as anticipated.

The main objectives of the maritime transport: safety of the ship, safety of the crew, safety of the cargo and protection of the environment still remain challenges for the modern navigation.

The technological progress that brought on the ships bridges the latest electronic navigation equipment: electronic charts, powerful ARPA radars, AIS receiver, satellite communications were supposed to make the activity of the OOW easier and to eradicate the maritime incidents. The problem still remains the human factor that cannot be replaced by the on board computers and still has to take the appropriate decision in real time.

The watch time involves team work for solving all the planned or unexpected activities.

For having good teamwork cooperation you must have in the first place a good communication between team members. Application of the team work management techniques tries to reduce the risk of errors appearance and to ensure the building up of a working environment where safety decisions will prevail.

Reality demonstrates that maritime accidents cannot be always prevented but a good team (on bridge or engine) can contribute to the reduction of the risk of occurrence for such accidents.

The modern navigation equipment (and all on board equipment) will provide information for a better understanding of the present and near future situation and can warn us about some assessable dangers but none of them will probably be able to detect a human error decision with a near future impact.

From the world studies based on tens of years of maritime practice and hundreds of maritime accidents conclusions, the human factor was responsible for more than 80% of these events.

After more than 15 years of ISM Code implementations, tens of years of Bridge Team Management (BTM) and Bridge Resources Management (BRM) courses, the analysis of the error chain in many of ships accidents revealed a lack of team work and an exacerbation of individual opinions and actions.

The ship's Master role is crucial for a day by day implementation of the shipping company standards and a routine application of the 'team" and "safety culture" concepts. Also the ship's Master is fully responsible for a real "ship's team" working environment where the "bridge team" and "engine team" totally cooperate all voyage long.

In the following chapters the authors will underline some of the practical aspects that are holding back the ship's Master to fully put into effect the above mentioned objective.

2. "TEAM CULTURE" & "SAFETY CULTURE"

One of the classic definitions given for "team" is fully adequate also for what seafarers can find on board a merchant ship: "A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they are mutually accountable" [1].

A good team is obtained after a significant time period of working together. Statistics show that building a team for a short period of time in order to fulfil a specific activity will not have usually a successful result, even if each team member has an individual great value.

The individual qualities are a great asset for a team, but the individuals must learn to cooperate and to complement each other for faster and better achieve the desired goal. It needs time to create the unity of a team, each team member needing some time to integrate inside the team and to cope with team work style and rules and to understand the weaknesses and strong points of the team. The adaptability of each individual to a team is the key word that should be considered when you do not have too much time at your disposal for building up an on board team.

Taking into account the specificity of the on board activities, where team members will change every 3-5 months, the coagulation of a team should be done in less than a 3-4 weeks maximum, even faster.

More than that seafarers should take into consideration that members of a new bridge or engine

team start to work together and should be efficient after only two maximum three sea watches.

It is a common practice that ships will leave the port just a couple of hours after the new crew members, including deck officers, arrived on board after very long flights from their home airports.

The ship will sail even if the deck officer is for the first time on board that ship and it is not fully familiar with the navigation equipment and the ships manoeuvring characteristics.

The new comer deck officer will take over the watch without having the chance for a few hours of sleep.

What kind of "safety culture" this practice can reveal?

On the other hand no owner or ship's Master can afford to keep his ship in port until the new arrived crew members will be fully briefed, accustomed with the on board equipment and integrated in their work team.

As maritime trainers know very well how the crew members exchange is planned and how difficult can be to try to have the new officer and the revealed officer on board together for a few days during the ship port operations.

Sometimes such an elaborate timing is carry on at the exchange of Captains or Chief Engineers, but not for the rest of the officers.

Table1. Principal nationalities: Officers
Source: MDeloitte Energy - Infrastructure & Utilities Group, Securing skilled crews in today's marketplace

Principal nationalities: Officers	Europe	North America	South Africa, Asia & Pacific
Nationality	Percent	Percent	Percent
Philippines	34	35	30
Indians	17	16	24
North Americans	-	1	-
Europeans	21	13	13
Balkans (Romanians, Bulgarians, Croats, etc.)	8	6	6
Ukrainians	8	1	-
Russians	2	10	1
Eastern Europe (Poles, Slovaks, etc)	-	3	5
South Africans	-	-	1
Other Asians (Indonesians, Sri Lankan, Pakistani, Bangladeshi)	1	3	2
Japanese	-	-	10
Other	9	12	8
TOTAL	100	100	100

The "Bridge Team" and "Engine Team" courses were requested by almost al shipping companies, without the need to be classified as compulsory by IMO.

Initially these courses were more focused on the ship operation, due the novelty of training capacities provided by the ship simulators. In the last 10 years the content of these courses wisely modified, being focused more on the team resources management with constant interaction of the trainees and using many case studies of real maritime incidents [2].

It is a fact that the on the ships' bridges the working climate modified over the years and distant attitude officer-helmsman or lookout changed towards on a more cooperative working environment.

Today we talk more about "safety culture" and "security culture" [3].

More than that, these two terms already combined and we actually have the "safety and security culture" as a whole.

Safety and Security duties are much easy to be defined, because in most of the cases they are based on individual responsibilities that can be quantified in most of the cases.

The "team culture" is based on human nature capabilities and consequently harder to define and also to control it implementation.

However, for a good and efficient on board day by day activity, all the above mentioned "cultures" should exist and co-exist, not only in the ISM papers, but in all crew working actions.

3. IMPEDIMENTS IN THE CREATION OF AN EFFICIENT BRIDGE (WATCH) TEAM

In the last decades in the policy of many shipping companies important changes were made regarding the on board personnel recruiting.

International and national labour law modifications allowed owners to employ foreign seafarers almost with no restrictions.

Consequently, these days 80-85% of the crews are international crews, with a great mix of people coming from very various cultures.

See table 1 and 2 to have a global image about the main nationalities that give seafarers for the labour market in the maritime sector [4]. As you can see from these tables, in both cases of officers and ratings, the distribution number of nationalities on board a ship can be easily greater than six. More than that, 90% of the today seafarers are not native English language speakers and in the case of ratings, most of them did not learn they English in school. Consequently the seafarers' proficiency in English language and the level of knowledge of maritime English depends in many cases only on the number of years spent on board merchant ships.

Theoretically this should not be considered a problem taking into consideration all the IMO and national Maritime Authorities efforts to implement the provisions of STCW and ISM Codes.

It is beyond any dispute that the maritime transport arrived to a worldwide applied standard that makes much safer the navigation of ships in almost all maritime areas of the world [5].

This standard applies not only for the deck officers or engineers but also for most of the ratings categories with important role on board.

These already implemented and functional standards are valid and well known by any crew member, transcending any nationality, religion, race, sex and native culture.

The ship's Master has the obligation to apply the owner's instructions and the international convention for creating an efficient bridge watch teams.

Also the Chief Engineer has the same responsibility for the engine watch teams.

The seafarers that will go on board a ship are selected by the owners or by the crewing companies. Their professional knowledge is tested using dedicated software (COLREG, CES 6000, Marlin, etc.) but their human behaviour is not usually tested.

Individual behaviour should be observed on board by the ship's Master.

The successful execution of a voyage is the result of the entire ship's crew effort and mainly of the bridge and engine teams, with the permanent help and support provided by the Master.

Table 2. Principal nationalities: Ratings
Source: MDeloitte Energy - Infrastructure & Utilities Group, Securing skilled crews in today's marketplace

Ratings	Europe	North America	South Africa, Asia & Pacific
Nationality	Percent	Percent	Percent
Philippines	75	83	72
Indians	-	8	18
Indonesians	-	2	2
Scandinavians	1		-
Russians	1	3	-
South Africans	-	-	1
Other Asians	17	-	7
Other	6	4	-
TOTAL	100	100	100

Every team is formed by individuals.

Each person has his own feelings, fears, believes, emotions, etc.

The problem is how all these personal human characteristics are expressed in a special social environment provided by the on board maritime ship's life.

There will be always some possible barriers that can make more difficult the consolidation of the bridge or engine teams.

The authors will focus only on the most common ones:

- Communication: On almost all maritime ships the on board spoken language is English.

The level of English language knowledge is essential for ensuring a good and efficient communication mainly for the bridge team members [6].

Because the safety of the ship is decided on the ship's bridge the maritime English should be a strong point for all the deck officers.

Usually the English language barrier appears at the young officers at the beginning of their carrier. If they considered that are not very good English speakers, they will avoid communicating with the rest of the team members and also with the other crew members.

They will try to identify a conational inside the crew and they will try to stay together as much as possible for speaking in their mother language [7].

There were many cases when the watch officer called the Master for sending a VHF report, or when the deck officer could not find the write English words for telling to the pilot that his decision was wrong because the own ship position is not where the pilot supposed to be.

The Master can improve the confidence of the deck team members by coming day by day on the bridge and start a dialog with the watch officer in order to improve de speaking capabilities of the young officer and also to improve his confidence in communicating in English [8].

Also it is easy to have on board a computer or laptop that is running Maritime English dedicated software as Marlin or MarEng.

- Fear of revealing own opinions: One of the main reasons that lead (first in the aviation industry) to the necessity of the crew team training was determined by the need to improve opinion exchange between the team members with different ranks.

On board ships this subject is more sensitive than on board a commercial aircraft, because the team can be larger with multiple nationalities, coming from different cultures and also the difference in hierarchy is greater.

Consequently, speaking in the first place of the young officers, they usually prefer not to argue against the ship's Master or superior officers considering that the ones with much more practical experience are always right [9].

They fear to express their considerations in case of a debate, for avoiding to be considered less trained or worst, to be radicalized by their superiors.

There are only a few culture (North American, North European) were freely sharing your thoughts to superiors is considered a normal behaviour.

In most of the world cultures, the respect for the superior implies that he is always right and a contrary opinion will be considered as an offense.

The things are worst from this point of view in case of the ratings which are composing the bridge or engine teams, mainly if they belong to an Asian culture.

The Master role in crucial for helping the crew members to overcome this communication barrier, mainly when he really wants to know the opinions of his officers during a voyage briefing meeting (for example) [10].

The nationality of the Master could be also very important because in most of the cases will reflect his general education and leadership pattern. As teachers we have to underline that maritime leadership training is not part of the academic maritime curricula in most of the maritime universities, maybe excepting the merchant marine officers trained in naval academies.

Being a very sensitive subject, the crew members, including the officers, will immediately observe the

preferred behaviour of the Master or of the senior officers and how to they like to be approached.

The fear of revealing own opinions in front of the superiors remains an aspect that was not and will be not (in our opinion) totally overcome by the Bridge Team Management (BTM) or Bridge Resource Management (BRM) training.

- Hiding or distorting events: The ship's Master shall be informed by the watch officers about all events that involved the ship not only during the sea watches but also during the port operations. Missing or misleading information can ignore some events with possible consequences in the near future or worst; can generate wrong decision in vital moments.

The officers can try to hide some events happened in their watch fearing that they will be blamed about it and penalized at the end of the contract by the Master in the evaluation form [11]. This is a normal human reaction and in many cases is very hard to overcome this impulse. All the watch officers should realize that today, due to the compulsory presence of VDR (Voice and Data Recorder) systems on each ships, actually all their activities are recorded and can be sooner or later discovered and analysed, mainly in case of an negative incident.

Sometimes the English language barrier can make the OWW to avoid to speak about the event because he cannot expressed it very well, or the words used will distort the facts. As we can see the language barrier is a factor that will be always present on board a ship with a multinational crew and all superior officers should realize this aspect.

Once again the Master's management style will play a crucial role in increasing the confidence of the crew members that they will not be penalized for their mistakes without a proper analysis of the case and total consideration of circumstances.

- Underestimation or overestimation of own capabilities: is a risk for the team.

Usually, in case of young officers, underestimation of the professional skills and consequently fear or hesitation in taking decisions can be encounter. In normal duty conditions the underestimation of own capabilities will not cause major problems because the officer will be very prudent and will try to analyse all the available information before taking a decision. But in case of some emergencies his hesitation can lead to the aggravation of the situation and even can cause accidents, because the it is possible that the officer to not call in due time for the help of the Master or other senior officer.

Overestimation of own potential is observed more frequently with the senior officers with long sea practical experience.

In their case, the risk is to not consult the rest of the team and take unilateral decisions [12]. Overestimation of own capabilities coming from a young low skilled officer is much more dangerous that in case of senior officers. In the last years, during the maritime training period we saw many students that considered herself very well theoretically prepared but their performances during maritime simulation conditions were not so good.

The Master should deal mainly with the underestimation problems, because the risk of errors generated by hesitating decisions and actions is greater than in case of the unwavering actions.

Also the overconfident officers should be tempered and guided to act as part of the team and not only by themselves.

- Routine: can be characteristics for officers with a long sea experience.

In most of the cases, they decisions are mainly based on their previous practical experience without a deep analysis of all the new situation parameters.

The feeling that "nothing new under the sun" can appear in their watch can easily led to a bored and inattentive phase where the developing events around own ship will be noticed with a significant delay or even left unnoticed [13].

The ship's Master should monitor the watch habits of all officers and to impose a responsible attitude all over the watch time.

- The conflict between generations: it is inevitable in any society so can arise also inside a ship crew.

Usually is the old school - new school education confrontation and in most of the cases it will be a dispute between young officers and senior officers.

Multitude of computerized on board equipment, including navigation equipment, it is always suitable for the younger officers and more uncomfortable for senior officers which will try to keep in place the traditional navigation methods.

For example the extensive use of electronic chart with sophisticated ECDIS equipment is very convenient for the young officers that already received in maritime universities such training based on simulation [14]. In the last 30 years there was a never ending debate regarding the effect of new technologies on board ships and mainly related with the ships' bridges equipment integration. The fear of losing control of the equipment automatics and creating a deck officer dependent of the information provided only by the electronic equipment still is an important risk factor in the human-machine interaction [15].

Senior officers will always prefer to see the ship's route on a printed chart and sometimes will be confused by the multitude of functions offered by the ECDIS.

The younger officers should disseminate their knowledge regarding the use of the new electronic equipment and the senior officers should always underline the danger of overreliance on the electronic equipment, mainly for navigation.

5. CONCLUSIONS

The ship's Master and the Chief Engineer are the two key responsible for creating a good, fair and encouraging working environment on board the ship.

If the two main section of the crew (deck and engine) are not divided by the conflicts between the Master and the Chief Engineer, than the cooperation between all crew members can create an efficient team work ensemble.

The second important aspect is the human quality of the crew members and their commitment for what the seafarers' spirit really means.

As previously stated, the Owner's crewing department or the Crewing companies do not psychologically test the seafarers that they recruit.

But years of seamanship practice proved that any seafarer that remained in this business more than 5-6 years was able to adapt to the on board life rudiments and learn to integrate in the on board ship's family.

An on board team has only a few hours (2-3 sea watches maximum) before becoming fully operational and ensure the safety of the ship, crew and cargo.

He hope that the new generation of officers with a more global understanding of the world realities and differences will be more opened to the communication with other people no matter their nationalities and cultures.

Communications is the main factor that helps a team to coagulate and to improve the team's effectiveness. Today on board communication is much more complicated than 20-30 years ago due to the multinational composition of almost all crews. We can have a great diversity of nationalities and cultures inside a crew which is encouraging the apparition of small group of people (2-4 persons) of the same nationality which will prefer to freely communicate between them and to limit the rest of the communication with the other crew members only to the working activities, w8ithout too much socialization.

Theoretically the young people should be more opened to new experiences and to meet with new people, mainly when confronted with the limited on board ship space and community. In reality, as in the on shore life, the young seafarers will focus your on board free time around the use of their personal laptop, watching pre-recorded movies, serials or playing various PC games.

The times when all the free crew was meeting together every evening after dinner for watching a movie recorded on a video player tape were long gone. On some ships, if an old fashion Master is in command the seafarers can have from time to time the so called "stern parties" with barbeque and soft drinks were all the crew (excepting watches) is invited. Such events were a very good opportunity for the crew members to better know each other, to exchange life stories, to share their happy personal events or to talk about their home warries.

At Constantza Maritime University the maritime teachers always tried to encourage our students too freely express their ideas and opinions in the seminar or laboratory hours. On the other hand the authors also tried to present them the particularities of the real on board life.

During the maritime simulation session that are part of the Radar Navigation, Ship Handling, ECDIS, Voyage Planning & Execution courses, etc. the students work in teams of two up to four, trying to replicate the bridge team activities from on board a real ship [15].

Instructors are monitoring not only the fulfilment of the simulation objectives but they also observe the involvement of each team member in the given activity and how the students are able to work together for solving the tasks.

The debriefing sessions of the simulation training analyse each team specific training results, but the instructors talk also about the co-operation inside the team for working out the imposed duties [16]. Over 15 years' experience of teaching navigation with the help of maritime simulations demonstrate that the "learning from own mistakes" method is more efficient for the Romanian maritime students. This system can be successfully applied with cadets that are really implied in solving the tasks during a simulated navigation scenario and that are considering also the exercise as a challenge between the different bridge teams in which the class is divided.

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STUDY REGARDING THE CADETS AND YOUNG OFFICERS' ACTIVITY ON BOARD SHIPS

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ABSTRACT

A four years study was conducted with a participation of around 650 students and graduates that already had a practical sea experience of 6 to 18 months. These students and graduates were embarked as deck cadets, able seaman or helmsman. The study also includes about 200 already certified deck officers with around one year sea experience, officers that were also enrolled to the master programs of the Navigation Faculty. Analyzing and testing the study subjects' practical skills, we were able to identify a series of elements that can have a long term negative impact on the practical training of the deck cadets and officers, most of them related with the safety of navigation. The main purpose of this paper is to underline these negative aspects and to propose some corrective solutions.

Keywords: *bridge team, team work, IMO, navigational, sea watch.*

1. INTRODUCTION

The International Maritime Organization (IMO) stipulated since the implementation of the STCW 95 Convention that the on board practical training for the future deck officers should be of 12 months. This requirement was maintained in all the other consecutive amendments to the STCW 95 convention, including the major updates imposed by the Manilla 2010 Conference [1].

In the beginning such a provision was hard to be accomplished and it was a great challenge mainly for the maritime schools, but soon enough the shipping companies understood that they have to support the practical training of the maritime students. The cadets training program was implemented by all major owners all over the globe and between the years 2000 and 2008 the request of deck, engineer and electrician cadets was very high. It was the best time for the maritime students to easily accumulate the mandatory on board stages because all the shipping and crewing companies were asking and accepting without problems a large number of maritime students.

The main reason of the on board practice was to prepare the future officers also with the professional and social realities of the on board life [2] and make also a good selection of the youngsters that will really want to become seafarers. It was obvious that only the theoretical knowledge was no more sufficient for becoming a good maritime officer mainly because all the fresh officers of the watch should face the specific responsibilities and duties of the function from the first moment when they step on board the ship. In the context of the large internationalization of the maritime sector and the generalization of international crews on almost all ships, there were no more time for familiarization and on board preparation for the new job after the ship was leaving the port. From his first sea watch, the young OOW should accomplish the entire task for safely sail his ship, being in charge of the bridge [3].

The content of the cadets on board training program also improved during these years, the major shipping companies tailoring their own cadets programs and recruiting also cadets for their ships directly from the maritime universities.

The final purpose of the cadets' training stage was to introduce the future maritime officers to the ship's routine and to make them understand the importance of a good watch team and how the theory learned in the maritime university match the true on board life, mainly from the point of view of navigation. It is important for the cadet to see with his own eyes the importance of the verbal communication between the crew members with its both aspects professional and social. Of course that the spoken language will be English language and the use of the specific maritime English terms will represent a day by day necessity. More than that, the cadet will realize that a lot of the theoretical knowledge that maybe was ignored during school time are required also in practice as a routine and all the others expect that the cadet is already possess this knowledge.

Unfortunately, because in these last years the number of cadets requested by the shipping companies diminished drastically [4], most of the cadets are completing their compulsory on board stages after graduating the maritime university. Consequently their learning process was already accomplished and some of them still have gaps in their professional education.

From the questionnaire that were fill in during our study we extract a series of conclusions related with the perception of the cadets on the on board life and what should be done for ensuring a smoother familiarization of the youngster with the on board social and professional environment. Our study focused on two main directions:

- The cadets' activity during the watches and the guidance support provided for completion of training tasks
- The activity of the already certified OOW and their practice during the sea watches for ensuring the safety of navigation, with an accent on the bridge team behaviour.

Some of the results will be presented in the following chapters of this paper.

2. THE CADETS' ON BOARD ACTIVITY

As stipulated before since 2009 the number of cadets requested by the shipping companies dramatically decreased. As a result more and more students from Constanta Maritime University (CMU) graduate without managing to finish their compulsory on board training. This means that after the graduations, the former students that are still determined to embraces a seafarer carrier to apply by their own to different shipping and crewing companies asking for a cadet position enrolment. Because the shipping companies cut the training expanses, many graduates had to accept on board positions as helmsman or able seaman [5].

One of the relevant items that can tell a lot of things about the cadets' training process on board ships are their training book and how it was filled in. The training workbook has a more or less standard format, based on the on board record training book edited by ISF (International Shipping Federation) [6] and covers all the aspects (chapters) of the practical training as mentioned by the STCW convention. The particular model of the workbook can be edited by the National Maritime Authority [7], by the Maritime University [8], by the Shipping Company [9] or it can be the original ISF record book. Anyhow, because The National Maritime Authority is certifying the completion of the mandatory on board training period based on the content of the record book, the model of this document should be previously accepted by the National Maritime Authority.

As a consequence, if a ship has on board three deck cadets, coming from different universities, it is very possible that they will have for different types of training record books. As we said before, the STCW training objectives mentioned in the workbooks are the same, but they are transposed in various themes that should be reflect the content of a specific training objective. These themes (subjects) can look very different from one workbook to another [10]. For the cadets this is not a problem, because usually he understands very well what he has to do for accomplishing that theme. The problem is for the supervising (training designated) officer that has to verify the work of the cadets [11]. More than that, it is very possible that not all record books are fully translated in English. Because most of the cases the accomplishment of various task mentioned in the record book should be signed by the Chief Officer or by the Master, we can often find remarks as "under language restriction" or "signed as Captain only for training record book".

As we all know, the content of this workbook may reveal the volume and quality of supervised practical activities that were undertaken by the cadet during his 12 month on board stages [12]. Having a vast experience after analysing hundreds of such record training books we identified some negative aspects related to this practical training process.

At the end of the 12 month training period for the deck cadets, we found that in the great part of the training books only 50-60% of the tasks were completed. Less than 20% of the workbooks had 80% of the tasks completed and only about 5% were with all (100%) of the tasks fill-in. actually the proportion of the tasks completed is in a reverse proportion with the complexity of the workbook. It is not only the fault of the cadet, but also the fault of the designated training officers which did not guide and help the cadet to carry out all the tasks. The best results were observed at the cadets that were selected by the major shipping companies. In almost all the cases such shipping companies have their own edited training record book and some of the tasks are trying to familiarize the cadet with some specific aspects of the company policy. The on board training program is also well organized by these owners, and the designated training officers take very serious they role as instructors for the deck or engine cadet [13].

The on board training program should be well balanced between the number of hours spent by the cadet on the ship's bridge plus other specific OOW administrative duties and the rest of activities, including deck work and other seamanship activities. This balanced should be ensured mostly by the Master or the Chief Officer, but also the Shipping Company has a great responsibility in imposing such a policy. From our students' responses, we observed that in the majority of cases, mainly where the Company had not a specific cadets' training policy and the Master was free to decide by his own [14], the number of hours spent by the cadet on the bridge were by far overcome by the physical on deck activities. The situation is worst when the cadet had to change a few the shipping companies until he was able to accumulate the compulsory 12 month of embarkation. Ion our case, the most fortunate students were the students recruited by top shipping companies that have their own well defined training programs, as Maersk or NYK.

In our opinion a daily program of 4 hours on the bridge and 4 hours of seamanship activities can be applied for the first half of the on board training period (6 month). The second part of the practical training process should contain in a proportion of 80% hours on the bridge dedicated to the sea and port watches and for the administrative duties mainly of the 3rd Deck Officer. But in order to ensure to a cadet such a program, someone has to take care of this balance and this could actually be done if the cadet has to change the ship and also the shipping company [13]. In such a situation the cadet will actually start every time the training process from the beginning.

The cadet will need also extra hours for filling in the training record book themes. In case of a shipping company with high quality training cadet's programs, the Master is sending each month to the Company the themes accomplished by his cadets for verification and validation.

Many of the themes that should be completed by the cadets (mainly the engine cadets) require the use of different ship technical manuals, plans, technical schemes, etc. A significant number of students reported that it was very hard for them to obtain from the senior officers such documentation and also the access to these documents was limited. We have to mention that for a cadet it is difficult to understand correctly from the first time the content and how "to read" the technical scheme of a complex on board installation (system). Without proper guidance and help of the senior officer it is very

possible that such plans won't be understand correctly and from the very beginning the student will gain a knowledge that can contain errors and mistakes of judgment that will be very hard to correct in the future. This is way it is very important to have a designated officer that had to supervise the on board training process of the students. Only answering to the students' questions, even if sometimes the cadets demonstrated that he has some gaps in his theoretical knowledge, the future OOW could correctly understand a process and gain the right technical skills required by the profession . If the on board learning environment is not an encouraging one, the cadet will lose his willing for asking questions and he will try to accumulate the knowledge by his own which will considerably diminish the efficiency of the training process.

Of course that we had also a few cases (7%) where the students did not understood the significance and the importance of this on board training period. Actually they did not found the motivation for ascending for a maritime officer carrier. Of course that in most of the cases they arrived on board ships were the cadets' training programs was not a priority and the senior officers (Master, Chief Engineer, and Chief Officer) let them to choose what they want to do, without any pressure. The main concern of these students was the remaining number of days until the end of the contract period for flying back home. In a very few cases (1%) the cadet could not comply with the ship's rules and could not adapt to the on board life, so the Master had to decide to disembark them and repatriate.

For summarizing, the most negative aspects are related to:

- At the end of the on board training period many record books are incomplete, with important themes missing. In our opinion the designated persons for the cadets' training should be more careful when they are signing and stamping these workbooks. Also the shipping companies that are accepting cadets on board their ships should reinforce their training policies and ask more responsibility from the Masters and Chief Engineers in this matter;
- Lack of interest from the cadets for fulfilling the tasks mentioned in the record book. Maybe there are going through the specific on board activities and gain the required practical skills, but they are too lazy to work also the themes mentioned in the record book;
- The distant and superior attitude of the on board officers that is discouraging the cadets interest for asking questions and learn under a proper guidance and supervision. Once again the shipping company has a great responsibility in making the Masters and Chief Officers aware of their very important role of trainers for these young future maritime officers. The Masters and Chief Officers should realize that in their hand also is the future of maritime transport and they can contribute in a decisive manner to shape well trained new seafarers;
- Non conformities of the on board training schedule, with a reduced number of hours on the bridge and too many hours of seamanship activities. We all agree that the seamanship work should be part of the basic deck officers training and without this knowledge they will cannot order, verify and supervise the activities of the deck crew, but learning how to perform a safety sea or port watch is maybe more important, mainly at the beginning of the carrier as certified officer.

In normal conditions the on board training stages should be felt by the cadet like an interesting, challenging and positive period, without the stress of the OOW day by day duties and responsibilities. Actually, most of the students claim that their first contact with the on board life and activities was full of unpleasant memories. Of course that this feeling is a totally subjective one, but in most of the cases is reflecting the attitude of the crew (including officers) in their relationship with the cadet. Unfortunately this first perception of the on board life could be decisive in the student decision if he will continue such a carrier or not. Of course that the most determined will try to go also on a second voyage and maybe already having some on board experience, this second training stage will be more pleasant than the first.

3. THE ON BOARD ACTIVITIES OF THE OOWs

The content of this chapter is dedicated to the answers received to our questionnaire from the already certified deck officers, most of them being 3rd and 2nd deck officers (officers of the watch – OOW), but also a few Chief Officers. These maritime officers were our university bachelor graduates and after some time they enrolled to the technical master courses offered by CMU.

In accordance with their answers 73% of them went on board for their first voyage as certified deck officers at the same shipping company were they fulfilled their cadet training period. More than that, many of them made their first voyage as officer on the same ship where the most part of the cadet period was spent.

One of the questions from our questionnaire was: "Have you felled afraid when you take over your first sea watch as officer?"

The answers are not very much different, but some of them are followed by more detailed explanations. Most of the answers (79%) contain a positive answer (Yes). In most of the cases the explanation given by the targeted peoples was related with the insufficient time spent on the bridge during the cadet training period. We had also complains regarding the very short time of familiarization with the bridge equipment before the vessel sailed from the port. In other cases, their first sea watch was at night in a high traffic maritime area and the Master had to remain on the bridge with the young officer almost all the time of the watch.

There were also a few situation (3% form the Yes answers) were the fresh 3rd Officer was not afraid by facing the responsibilities but of a previous dispute (from the on board training period) with one of the senior officers. In all these cases, that older dispute was not forgotten by the senior officers and they did not friendly welcome the return on board of the graduate, now certified OOW. It is very difficult for a young officer, at

the beginning of his carrier to face an individual conflict with a senior officer. The level of stress can become very high for the freshman, maybe not directly during his sea watches, but mainly for the rest of his admin activities. Of course that the worst situation is when the old conflict is with the Master but such cases are very rare, because usually the Master will refuse to take on board that officer. Anyhow, during the voyage such conflicts can raise, mainly during a stressful, long voyage and in many cases the dispute was amplified by the cultural differences among the team members [14].

From the remaining 21% of negative (No) answers to the above mentioned survey question, around 85% of them were determined by an over-evaluation of own professional knowledge and the desire to look brave. Only 15% from the "No" answers were supposed to be really believed by us. From these credible No answers, the major part come from 3rd Officers that had also an officer apprentice period on a position usually called "Junior Officer". This crew list position can be found mainly on the major shipping companies that can afford to pay a young certified officer without including him from the very beginning on the normal sea watch duties. The "Junior" position represents actually an extension of the cadet training period for another 2-3 months, this time with tasks 100% similar with OOW, but without the same official responsibilities. If the Master considers that the Junior Officers has the capacity to assume the full role as OOW, than usually he will be promoted on board as OOW after the disembarkation of one of the others OOWs.

It is a great chance for the freshman certified officers to have the opportunity to fulfil a brief period as Junior Officers, because this time he will be fully aware about his future responsibilities and he will be involved in all the on board required activities [15]. In some cases, the shipping company policy requires that the Junior Officer to fulfil other a few training themes for considering the "Junior" stage accomplished.

Another question in the questionnaire was: "During your watch keeping hours, do you make use of all the equipment, instruments and apparatus you have on the bridge in order to ensure the safety of navigation or to determine your ship's position?"

The great majority answered "Yes" /gave an affirmative answer/ but in the explanatory part of the questionnaire they did not mention some of the instruments and equipment still available on board, which they practically did not use at all. The very few who gave "No" answers did not offer any supplementary explanations about it.

Thus, in connection with ocean passages, very few (10%) mentioned that one of the first methods of exact determination of a ship's positions is obtained by taking astronomical observations with a sextant as well as from the information given in nautical publications like Sight Reduction or the ephemerides found in Nautical Almanacs. The remaining 90% resorted only to the information provided by the GPS. In the supplementary explanations one Chief Mate even stated that "The sextant is but a museum piece and is no longer used on board ships. As a matter of fact I rather doubt that it still exists."

Nevertheless, port authorities, through the agency of the Coast Guard and Port State Control, include in their control lists items like "celestial navigation or "astronomical position", in order to verify if ,during passage, the ship's officers have also determined the position by means of astronomical observation

Again, very few (15%) said that in the case of close-quarter navigation, when landmarks are conspicuous, they used the alidade /bearing finder/azimuth finder/ and the bearing repeater/gyro-compass repeater/ in order to determine the ship's position by means of coast marks.

It is much easier and more at hand to use the radar and so they got used to do that, all the more as some ships have a radar mounted in the chart room, and so they do not have to get out of the bridge and waste time in finding the landmarks. More than that, the great majority stated that they use the GPS system all the time, even when they navigate close to the coast.

Although not all ships are equipped with meteo chart facsimile, it was found that even when they are, this apparatus is considered no more than a furniture piece. At present, deck officers are content with the information provided by the GMDSS, NAVTEX and VHF, or in the case of passages, by the coast radio stations, if an Ocean Route Weather Service is available.

Another question in the questionnaire for officers refers to the watch keeping team: "Did you come up against any difficulties in integrating with the watch keeping team that was already on board before you're joining it? Do you consider that during your period aboard the ship you really understood the meaning of the phrase "team work" and acted accordingly?"

About 72% gave an affirmative answer and further explained that the experience acquired as officers during the 2-3 previous voyages enabled them to understand what the watch keeping team meant. No doubt that the first days were somewhat difficult until they got accustomed with the senior members of the team, but generally there were no problems that could be interpreted as' weak links'. Team work comes as a natural process once the officer is integrated in the watch keeping team; evidently, a good team cannot be built up if there is animosity or disagreement among its members.

The remaining 28% gave a negative answer; they explained that they did not succeed working in a team, or, if they did, they permanently felt an unbearable atmosphere around, totally inadequate for carrying out their watch keeping duties. One of the officers complained that" The Chief Engineer behaved as if he knew everything and never consulted with the Second Engineer or The Captain, no matter of what activity was being carried out. And even when the work results were good, he was never satisfied or appreciative. As a matter of fact, during the whole period of my contract I worked under stress and feared that what I was doing was wrong,. I never heard a word from him meant to encourage or motivate me".

In the specific maritime documentation, more exactly in the "Bridge Team Resource Management" and in the IMO "Personal Safety and Social Responsibilities" courses the attendants are informed about the obstacles

that may negatively influence on board relationships [16]. They may be either caused by the conflict between generations or the level of reference which illustrates the perception of cultural differences is situated at a primary, parochial level of "I know best and you must comply".

4. CONCLUSIONS

From the questionnaire addressed to cadets and officers this paper presented only a few of the questions and answers, with given explanations. Gathering and grouping all the data were done according to the period of embarkation, type of ship, crew structure, rank on board, age of the respondents and crew members of whom the watch keeping team consisted.

Being a cadet should stand for one of the most pleasant embarkation period, during which the future officer can "see" what awaits for him in the near future.

It is a period when his practical skills are formed and when he must prove that he is able to take over the responsibilities and obligations of a watch keeping officer. A cadet must understand the fact that on board he is not a simple passenger and that he is expected to show interest and initiative, come up with proposals and ideas, in short do anything showing his implication in the ship's activities.

Unfortunately the bond between the shipping companies it is not very substantial in many maritime countries. Maybe if the on board training process will be supervised also by teachers with maritime background send by the maritime universities and accepted on board by owners, the cadets' training process will be more successful [17]. The idea is not to transfer the practical training responsibility from the ship's Master, Chief Engineer or Chief Officer towards the university's instructors, but to give the cadets the feeling that their on board compulsory training stages are also a period of learning.

At the same time the ship-owner companies should encourage shipmasters and chief engineers to manifest understanding for the cadets' lack of experience and place an important accent on their presence as long as possible on the bridge or the engine control room.

Also, cadets and officers, including the captain should be aware of the fact that the management of the watch keeping team is more than a concept. It is the implementation of the work was based on the navigation standards required by Maritime Organizations which demand from all the persons involved to make the best use of the human and material resources on board with a view to successfully attains the proposed aim/purpose/task.

Moreover, the management of the watch keeping team is meant to explain how to organize a voyage in such safety conditions, that no matter whom the responsible person on the bridge might be, everything will be properly seen to.

And, not last but not least, everyone involved in maritime activity/adventure should always bear in mind that all the efforts made in this activity have only one purpose: a safe voyage to the destination, the safe delivery of the cargo in the same state as when loaded, the safety of the crew and the protection of the marine environment.

This paper does not aim to bring accusations or to ascertain who is guilty of some less pleasant aspects on board a ship. It is only a statement of some facts that can render difficult the activity of all those on board a ship.

Any company that is involved in shipping and wishes to have well trained personnel should be able to predict in advance (think even from the start of) what the future will bring and of how well trained the next wave of "sea-wolves" are. Thus, a company will have the possibility to select the best and the brightest. Otherwise the colour of the future will be a very gloomy, unpleasant grey.

"The wind and the waves are always on the side of the ablest navigator". (Edmund Gibbon-Historian)

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SAND STORMS AND LOCAL WINDS OVER AFRICA COASTS. NAUTICAL STUDENTS BACKGROUND KNOWLEDGE

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ABSTRACT

Sand storms and local winds are topics included in marine meteorology lectures taught to nautical students, especially because of their impact on coastal navigation such as the reduction of visibility at sea. Local winds names are part of the marine vocabulary and information about such phenomena can be found in the meteorological bulletins and warnings received onboard, as well as in the coded observations and the synoptic and prognostic charts. The purpose of this study is to highlight the importance for nautical students of the background knowledge in lithometeors characteristics and in forecasting weather from synoptic charts.

Keywords: *sand storms, Africa, synoptic conditions, harmattan haze, visibility on sea.*

1. INTRODUCTION

This study was inspired by the questions addressed by Nigerian students in Navigation during lectures on weather phenomena taught in Constanta Maritime University and by the accounts of the severity of sand/dust storms they experienced.

Lectures in Marine Meteorology include the description of those lithometeors and local stormy winds with direct impact on navigation. The main consequences consist of the reduction of visibility on sea but also in thermal discomfort and unhealthy breathing air.

The occurrence and development of sand/dust storms is either an important process of the acceleration of land desertification. Saharan dust is transported from its source areas along several trajectories: westward over the North Atlantic Ocean to North America and South America; northward across the Mediterranean to southern Europe; along easterly trajectories across the eastern Mediterranean to the Middle East [1].

The Harmattan wind system is presented in this study; it determines dust or sand transport from the Sahara desert over the African coasts westward and northward respectively.

Sahara accounts for almost half of all the aeolian material supplied to the world's ocean. The main source regions are: the Bodélé Depression and Lake Chad together with large portions of Mauritania, Mali and southern Algeria. Other important sources are the Horn of Africa, the Nubian Desert in southern Egypt and Northern Sudan.

Dust or sand coming from the Sahara can be transported over great distances as far as the Caribbean Sea, the Amazon Basin, the United States and Europe [11, 12, 8, 4]. Over the sea, dust particles could be coated with sea salts and they could act as ice and cloud condensation nuclei, hence playing a role in the formation of rainfall [5].

The studies on the consequences of these meteorological hazards focused especially on the impact on road and aviation transport. As they represent a risk for navigation (fig. 1), it is important for students in Navigation to learn more about the genesis conditions, the period of maximum frequency and the forecast of dust or sand storms associated with different local winds. When learning these aspects, students already have knowledge in pressure systems, wind systems on earth and interpreting a weather chart.

Figure 1 A sand storm over the Suez Canal [18]

2. LITHOMETEORS CLASSIFICATION

Lectures taught to students contain descriptions of phenomena observed in the atmosphere or on the Earth's surface according to WMO guides. These phenomena are: precipitation (hydrometeor falling through the atmosphere), suspended or blowing particles (hydrometeors and lithometeors), optical phenomena (photometeors) and electrical manifestations (electrometeors).

Lithometeors are solid and non-aqueous particles, suspended in the air, or lifted by the wind from the ground, such as: dust in suspension in the air, dust or sand raised by wind, a dust storm and sandstorm caused by turbulent winds raising large quantities of dust or sand into the air and reducing visibility severely, dust or sand whirls and, occasionally, funnel clouds.

Sand is frequently driven along the ground by a strong wind without being lifted into the higher air layers (called "sand drift"). Dust consists of smaller and lighter particles than sand. Once raised from the ground, dust

particles are transported by upward or other irregular currents over great distance.

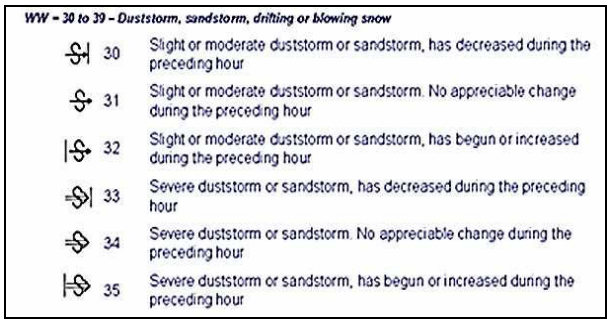
Blowing dust or *blowing sand* is dust/sand raised by the wind to moderate heights above the ground and restricting horizontal visibility to less than 12 km [17]. During *dust/sand storm*, visibility is reduced to less than 1 km (1/2 nautical miles) but not less than ½ km (¼ nautical miles). During *severe sand/dust storms* visibility is reduced to less than ½ km (¼ nautical miles).

Dust walls are impressive phenomena associated with the transport of dust and sand raised from the ground to considerable altitude (fig. 2).

Figure 2 A dust wall over the Niger river, Nigeria https://www.pinterest.com [19]

Dust/sand whirls (dust devils) are rapidly rotating columns of air usually over dry and dusty or sandy grounds which carry dust and other light material picked up from the ground. Dust or sand whirls are a few metres in diameter and they extend no higher than 60 to 90 m [16]. Well-developed dust/sand whirls in very hot desert regions may reach 600 m.

The symbols students should recognize on daily charts are:



WW = 30 to 39 – Duststorm, sandstorm, drifting or blowing snow	
30	Slight or moderate duststorm or sandstorm, has decreased during the preceding hour
31	Slight or moderate duststorm or sandstorm. No appreciable change during the preceding hour
32	Slight or moderate duststorm or sandstorm, has begun or increased during the preceding hour
33	Severe duststorm or sandstorm, has decreased during the preceding hour
34	Severe duststorm or sandstorm. No appreciable change during the preceding hour
35	Severe duststorm or sandstorm, has begun or increased during the preceding hour

Figure 3 Dust/sandstorms symbols used on daily charts [16]

Another type of lithometeor listed in the Marine Observing Handbook is *haze* – "a suspension in the air of extremely small, dry particles invisible to the naked eye and sufficiently numerous to give the air an opalescent appearance". Haze particles may be composed of a variety of substances (dust, salt, pollen, volcanoes residues), generally well diffused through the atmosphere.

3. LOCAL WINDS OVER AFRICAN COASTS

Local winds are listed by their local names in nautical publications (fig. 4).

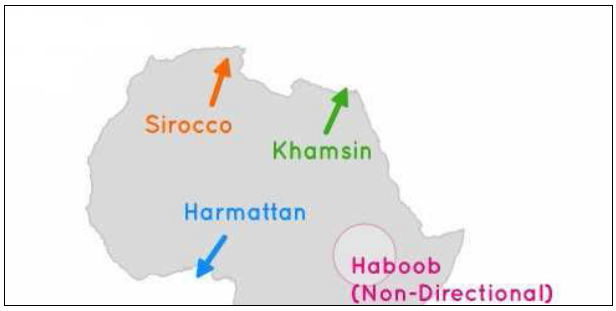


Fig. 4. Local winds from North Africa (figure source: www.thecompetitionworld, modified)

The *Harmattan* is defined as a ground level stream of dry desert air which is part of the African continental trade wind system that sweeps far southward from a consistent NE direction. This wind is more frequent during winter months and it transports large amounts of dust from the Chad basin to the Sahel and Guinean coast where it reduces visibility, relative humidity and temperatures. The effect caused by the dust and sand stirred by these winds is known as the *Harmattan Haze*.

In some West African countries, the heavy amount of dust in the air can severely limit visibility and block the sun for several days, comparable to a heavy fog. The phenomenon cause irritation of respiratory tracts and visibility reduction in car and air traffic that represent a serious problem during dust spell events.

The *Harmattan* generally occurs between Cape Palmas in Cote d'Ivoire, west of Nigeria (4°22'N., 7°44'W.) and Douala in Cameroun, east of Nigeria (4°03'N., 9°41'E.), [15], fig.5.

Figure 5 Guinea Gulf coasts between Cape Palmas (red circle, west coast) and Douala (red circle, east coast). Figure web source: www.bbc.co.uk, modified

When the wind force of the *harmattan* is beyond the threshold value, sand particles and dust particles will be blown away from the land surface and transported for several hundred kilometres to the Atlantic Ocean.

The *Sirocco* is a southerly wind, hot and dry, which blows from the Sahara to the southern Mediterranean. It picks up moisture as it crosses the Mediterranean and can reach Spain, France, Italy and Greece, bringing Saharan dust and hot, windy, damp weather, often with fog or low stratus clouds. Local names for Sirocco are:

Simoom, Ghibli (in Libya), Chili (in Algeria and Tunisia), Khamsin (local name in Egypt), Leveche etc.

The *Khamsin* is a Sirocco wind, hot, dry, dust laden wind over Egypt, the Red Sea and eastern parts of the Mediterranean Sea. Like the sirocco, the khamsin is usually blowing ahead of depressions which move eastward or north-eastward in the Mediterranean Sea or across North Africa, with high pressure to the east. It occurs during the period February to June, being most frequent in March and April. The name is derived from the Arabic *khamsun* or *hamsin*, meaning fifty, for the approximate period of days during which it blows. Less frequently the khamsin might also occur in winter as a cold, dusty wind.

4. THE *HARMATTAN* SYNOPTIC PATTERNS. A STUDY CASE

In Nigeria the frequency of sandstorms is less important in the south part (including the coastal area). South of 7°N there are only few or no occurrences of sandstorms, basically attributable to the overwhelming influence of the moisture laden South Westerlies irrespective of the position of the Intertropical Convergence Zone (ITCZ) [10].

However, massive sand transports have been recorded over the land and the Nigerian coastal area. Such a case, from February 2005 is presented in this paper because its impact on visibility and therefore on coastal navigation.

Generally the *harmattan* wind is a part of the African continental trade wind system [6]. The wind corresponds to the winter West African monsoon that blows from north-east. The summer monsoon begins its southern retreat in late August and the coastal rainy season ends in early November. The maximum frequency of the *harmattan* is from December to March [6, 11, 14, 20].

Atmospheric circulation is characterized by the presence of a high pressure area over northern Africa, which can be strengthened by cold air outbreaks from Europe and by a low pressure area over the southern part of Sahel, related to the northward movement of the ITCZ as indicated by NCEP/NCAR reanalysis, (fig. 6), [9].

The *harmattan* transports large amounts of mineral dust at irregular intervals from the Chad basin to the Sahel and the Guinean coast where it reduces visibility, relative humidity and temperatures [11].

Harmattan winds will blow from the high pressure area, bringing dust over the western Africa.

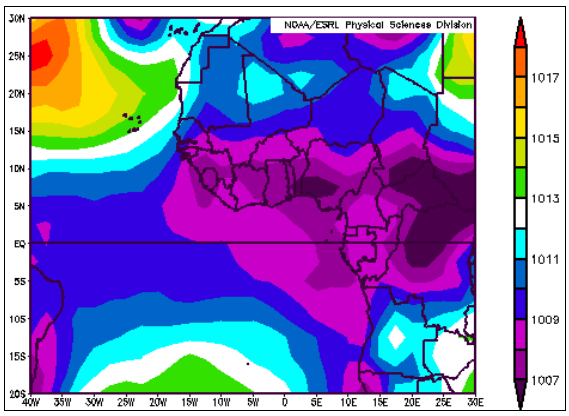


Figure 6 Distribution of sea level pressure for February, 15, 2005 on the Afro-Atlantic region

The existence of the *Harmattan front* is considered by Haywood et al. (2008) as a regionally significant feature in the winter months over West Africa. The front occurs regularly at night in January and February and its features (such as internal gravity current and bore-like structures) are generated from the continental-scale atmospheric dynamics [3]. It lifts dust from the surface and transports aerosols to high levels in the lower troposphere [7].

For February 16, 2005, Modis images show a massive dust storm which engulfs the West African and Guinea coast, with a maximum concentration of dust particles in the region of Nigerian continental shelf (fig. 7).

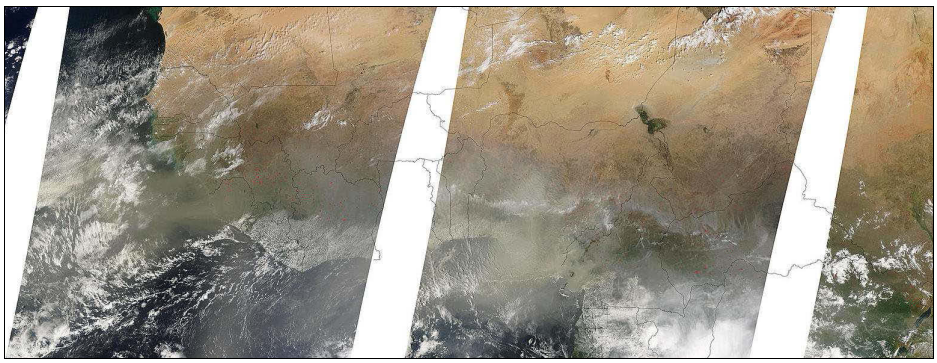


Figure 7 Saharan dust storms related to *harmattan* conditions along the coast of Guinea Gulf on February, 16, 2005

The atmospheric circulation for the previous days - recomposed on the basis of Hysplit techniques [13] - show in the region of Nigeria shoreline a lower atmospheric inflow from the ocean and an upper inflow from inside the continent (fig. 8).

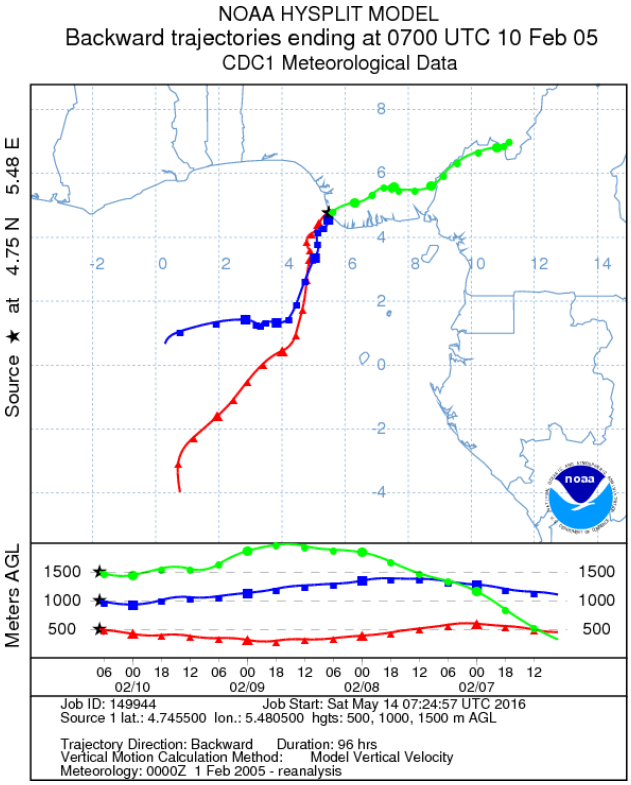


Figure 8 Backward trajectories of lower tropospheric particles from 500 to 1500 m altitude for 10.02.2005

In such conditions of *harmattan haze*, we can consider as specific for the Guinea coast (including the Nigeria shelf oil field) the mixing of warm and humid oceanic air with the cooler, dryer sand particles loaded air from Sahara. These conditions determine a complex bioclimatic stress reflected in a high degree of thermal discomfort, restricted horizontal visibility and unhealthy breathing air.

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THE CRIME OF SAILING A SHIP WITHOUT A LICENSE OR A CAPACITY CERTIFICATE, IN THE ROMANIAN LEGISLATION, SHORT PRESENTATION

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ABSTRACT

This paper's aim is to present the provisions regarding the current codification of crimes related to sailing. The crime of sailing a ship without having a legal document is a serious offence stipulated within the Romanian law, since it produces a state of danger to the well-being of naval traffic. This paper will also discuss the various ways in which a person can commit the crimes, the elements of the incriminating norm, and also will compare the different opinions present in current doctrine.

Keywords: *Sailing, crew, license, juridical object.*

1. LEGAL PROVISION

Within Law no 191/2003, we find in Chapter 2 – titled Crimes against civil security – a series of criminal acts codified with the same juridical object: the social relationships regarding normal underway of sailing[1.]

Article 2 of said provision states two forms of the assimilated crime, the sailing of the ship without a license or an adequate capacity certificate, and an assimilated form, whenever the sailing of the ship is being made by a person who suffers from a psychic disease or is under the inffluence of narcotic products, after the ship was being given to said person.

Therefor, in article 2, paragraph 1 of the previous quoted Law we find: „the sailing of the ship without a license or an adequate capacity certificate represents a crime and its punishment is jail between 1 and 5 years".

Paragraph 2 of the same article codifies a yet another profision, distinctly from the base form of the crime – „the action of a ship's commander, or any other person's to knowingly give the sailing of the ship to a person without a license or an adequate capacity certificate, or to a person whos sailing right had been suspended"

Article 2, paragraph 3 finds an assimilated form – the sanction of a person that knowingly gives the sailing of the ship to a person suffering from a psychic disease or is under the inffluence of narcotic products

Both distinct ways of commiting the crime found in article 2 paragraph 2 and 3 are sactioned with jail from 1 to 5 years.

Previous to this current provision (Law no 191/2003), the crime was found in article 108, chapter I, section I of the Decree regarding civil sailing, no 443/1972.

By comparing the two provisions, we can state that the romanian legislative body stated in article 2, paragraph 1 and 2 of the Law 191/2003 the same incriminatory text found in Decree no 443/1978, article 108 paragraph 1 and 2, without any difference text-wise.

2. PREEXISTING FACTORS

2.1 The object of crime

- The juridical object
- Generic juridical object

The crime codified by article 2 of the 191/2003 Law has as a generic juridical object the social relationships regarding adequate sailing, without the breaking of norms regarding sailing and without endangering them.

Within specialised doctrine the normal sailing has been understood as the sailing within safety measures

By safe sailing we understand „respecting specifical rules regarding sailing, that ensure the normal flow of naval traffic, water shipping, the safety and integrity of people and cargo, and also the exercising of sailing surveillance and control

- Special juridical object

Obviously the special juridical object of this crime must have a part of the social relations regarding water sailing safety. It is easy to observe that these social relations stem from and develop around the concept of safety when it comes to sailing done by persons who have been legally abilitated to do this activity.

Thusly, the social relationships that form the special juridical object of the crime are incompatible with activities regarding sailing that are done by unqualified and untested persons, within the provision of the law.

- The material object of the crime.

The crime stated by article 2 is a danger crime, and therefor it has no material object in its base form, and also in its assimilated forms.

Some authors claim, in the specialised doctrine, their opition that the material object represents the material body of the ship. (author Gheorghe Diaconescu and others)

We state that this opinion does not correspont with the will of the legislative body, stemming from the law.

The crime has, as a material element the action of sailig, or transporting the ship, guiding it on the water, and the result of such an action can only be a state of danger towards the safety of sailing, and by the simple act of unlafully sailing, there are no damages to be quantified, but only the rules of sailing are being broken.

2.1 The subjects of crime

- The active subject

The active subject of the crime in the form stated by article 2 paragraph 1 is a physical person, responsible criminal-wise, and no other condition is required.

We find controverses in the judicial literature regarding the active subject quality, and there is an opinion that the active subject is a member of the crew personnel.

In support of this opinion (professors Gheorghe Diaconescu, George Antoniu, Costică Bulai), it is claimed that the right to obtain a certificate or a licence can only be held by the crew.

Other authors (Alecu Alexandresci and others) claim that the active subject of the crime is the criminally responsible physical person, by argumenting that the law in question does not speicify that the active subject must have a certain type of specifical certificate in order to sail with a ship, or not have it at all.

We consider that this latter opinion is the one that is in accord with the spirit of the current law provision.

The legislative body uses the expression „sailing a ship by a person without a licence or an adequate capacity certificate"

By interpreting this text we can see that the physical person was considered first of all, then the refference is to any criminally responsible person.

If the desire would have been that the active subject is limited only to the crew, it would have been mentioned in the text, because being part of a crew is a quality that requires certain law imposed conditions, and the social danger of this crime would have been reconsidered.

On the other hand, if we were to accept as the active subject (as stated in article 2 paragraph 1) only the crew, it would lead to an exclusion from the sphere of active subjects all the other people that, by being on a ship – and not being crew -, can still commit such a crime.

Such an interpretation, by „reductio ad absurdum" cannot be recieved, because it would defeat the will of the legislative body , of sanctioning all such crimes, and not just some of them.

In the crime stated by article 2 paragraph 2 of the crime we find that the active subject is qualified, by being the captain of the ship, or any other person who is lawfully able to entrust the ship.

The provision in article 2 paragraph 3 has as an active subject a person that entrusts the ship, for it to be sailed

- The passive subject

In this crime, the main passive subject is the state, as the embodiment of the fundamental social values that relate to the concept of civil naval safety, and also, as the only entity that can legislate and control the civil navigation.

The secondary passive subject of the crime can be a physical or judicial person if any harm comes to pass as a result of the crime.

3. THE OBJECTIVE SIDE

3.1 The material element

The provision in article 2 paragraph 1 has as a material element the sailing action.

The sailing itself represent a complex operation of moving the ship on water, from one point to another, or guiding it to the shore, by using the ship's comands.

In order to find all conditions regard the material element, and in order for the action to constitute a crime, it is necessary that the sailing is made by a person without a licence or an adequate certificate. This condition that is in a connection with the material element must exist at the time of the crime.

Gaining the licence or certificate requires a set of legal imposed conditions that must be met and atested previous to the sailing.

Found in article 2 paragraph 2 the material element represents the entrusting of conduction of the ship.

Entrusting the ship means giving the ship to another person that is not legally qualified to conduct it. In order for the crime to exist it is neccesary that the person who has been entrusted with the ship actually sail it, and also, during the navigation, that person must not have a licence or an adequate capacity certificate, or that their right to sail the ship has been suspended.[3].

Found in article 2 paragraph 3 the material element is the action of entrusting the ship.

The meaning of entrusting is the same used in article 2 paragraph 2, dut the essential requirement is modified.

In order for a crime to exist, the entrusting must be made to a person that suffers a psychic disease or is under the influence of narcotic substances.

The entrusting must be made knowingly by the person who would give the ship, that the one who could sail it is in such a state.

3.2 The immediate consequence

The immediate consequence of the crime in article 2 represents a state of danger for the safety of the ship and the safety of navigation, and that means that the rules of sailing are broken and there is the posibility of an incident, because of a lack of legal training for the person sailing.

3.2 The causality connection

By being a crime that causes a state of danger, in the moment when the material element - the actual sailing (moving, conducting, shoring of the ship) – is commited, a state of danger is created, so the causality results ex re.

4. THE SUBJECTIVE SIDE

The subjective element from the subjective side is commited with intention, in both forms, both direct and indirect.

Regarding this crime the legal provision has no condition when it comes to motive or purpose, but, if they are known (and at least the motive should exist), they will be analysed when the sanction is given.

Participation in the crime stated in article 2 paragraph 1 is possible in all shapes, but then it comes to being co-authors, all of them must sail the ship.

The provision in article 2 paragraph 3 cannot have co-authorship, we state, since a ship has only one commander.

5. CONSSUMATION

The crime is conssumed when the material element is commited, meaning when the action of sailing the ship by the active subject begins. Practically, when the ship moves across water from where it was, the state of danger is created an the deed is done.

From this point of view we can see that the action is a continuous one, and the socially dangerous state stops when the sailing stops.

Attepting to commit this crime is not punished and also not possible.

5. SANCTIONS

The crime has a sanction of jail between 1 and 5 years in all of its forms.

6. AGGRAVATED FORMS

Provided in article 12 of Law 191/2003, if the actions from articles 2-5, 7-11 resulted in a navigation accident that produced extermely unfavorable consequences, the sanction is jail between 5 and 10 years and forbidding certain rights.

We can see that in order for the crime to be worse two essential conditions are attached to the material element, those being the creation of an accident with extremely unfavorable consequences.

By navigation accident, when it comes to the immediate consequence, we understand an action that leads to the damage of the ship in any way, by colliding with another ship, a pier, etc.

In order fo the aggravated form of the crime to exist the legal provision states that the accident must result in extremely unfavorable consequences.

According to article 183 of the romanian Criminal code, by extremely unfavorable consequences we understand a material loss of more than 2.000.000 RON.

7. REFERENCES

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Arrange references as follows:

[1] LAW NO 191/13 may , Lex expert program, Neamt Informatical Company

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GENERAL ASPECTS REGARDING THE CRIME OF TAKING OVER THE COMMAND OR CONTROL OF A SHIP, WITHOUT RIGHT

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ABSTRACT

Within this paper the author will present the provision regarding a certain type of crime related to sailing. The act of taking over the control or command of a ship will be taken into consideration, from its previous codification to its current one. Also the different type of aggravated forms will be taken into consideration. A certain emphasis when it comes the categories of active subjects that can commit such a crime will be explained. Also, the consequences of such a crime, representing sometimes extremely unfavorable ones, will have an analysis. This paper will also discuss the various ways in which a person can commit the crimes, the elements of the incriminating norm, and also will compare the different opinions present in current doctrine.

Keywords: *Sailing, command, crew, consequences.*

1. LEGAL PROVISION

Found within chapter 2 of Law no 191/2003, – titled Crimes against civil security – a series of criminal acts are codified with a common juridical object: the social relationships regarding normal underway of sailing.

In article 13 of this Law we find codified the crime of taking over a ship's control or command, the legislative body stating that as a sanction, such a deed can be punished by prison, in an amount between 2 to 7 years, and the forbiddance of a set of rights.

Such a crime was previously found in the now-repealed Decree number 443/1972 regarding the civil navigation, where, in article 123 it was stated that „ The disturbance of fulfilling service duties of a crew, if such an act would endanger the safety of a the ship, or the act of taking control of the ship, directly or indirectly, is punished by jail from 3 to 12 years".

If the crime is commited with the purpose of deviating the ship from its course, the penalty is jail from 5 to 15 years.

If, in order for the crime to be commited, a person has been killed, or if the act has lead to the death of a person or several persons, or other grave consequences, the penalty is death and the total confiscation of fortune, or prison from 15 to 20 years, the forbiddance of certain rights and the partial confiscation of fortune.

Attempting to commit such crime is punishable by law

The procuring or production of instruments or means, and also the safeguarding of measures, in order to commit this crime is considered to be an attempt"

First of all, we can observe that the criminal provision of article 13, found in Law no 191/2003 has been taken from article 123, paragraph 1, the third thesis, of Decree no 443/1972 regarding civil navigation, but with major differences between those two legal texts.

By the new codification, found in Law no 191/2003, the legislative body wanted to structure, in a clear and adequate manner, the provisions regarding water transport crime, compared to the one found in Decree no 443/1972 regarding civil navigation, where the legal provision would sometime relate to other types of crimes.

Practically, from this current point of view, we can find that an evolution of criminal legislation is in state, one also in accord with the new social and political realities, ones that would not correspond to the ones that existed when Decree no 443/1972 regading civil navigation, first came into being. However, some common tehnical elements still remain.

One can also observe that the sanctions in the new regulation are not as harsh, and also that the death penalty no longer exists, neither for the crime that is being analysed, and nor for other crimes, in general, such a penalty having been repealed after the year 1990 and replaced with life inprisonment.

2. PREEXISTING FACTORS

2.1 The object of crime

- The juridical object
- Generic juridical object

The crime found codified in article 13 of the 191/2003 Law has as a generic juridical object the social relationships regarding adequate sailing, such realationships being incompatible with the breaking of rules in the case of taking control of a ship, by people that have no legal ability

In doctrine the term „normal sailing" has been understood as the sailing with all safety measures, both for the ship, and for the crew.

By safe sailing, a different opinion states that it represents „respecting specifical rules regarding sailing, that ensure the normal flow of naval traffic, water shipping, the safety and integrity of people and cargo, and also the exercising of sailing surveillance and control [1]

- Special juridical object

We can observe that the special juridical object of this crime must have a part of the social relations regarding water sailing safety, and we can consider, in

this context, that it is formed out of the social relations that stem from and develop around the concept of safety when it comes to sailing done by persons who have the ability, legally proven, to do this activity.

Thusly, the social relationships that form the special juridical object of the crime are incompatible with activities regarding the comand of the ship, done by people who do not have this ability, and are not legally permitted to have such ability.

- The material object of the crime.

The crime provided in article 13 is a hazard offence, and such, in this form and in other derivated forms it has no no material object.

It is possible that, in certain aggravated forms of the crime, the material object is the body of the person who was put in danger or was harmed.

2.2 The subjects of crime

- The active subject

The active subject of the crime in the form stated by article 13 paragraph 1 is a responsible physical person, because no other condition is required by the law.

And such, any person cand commit such a crime, the only requirements being that they must have full responsability for their actions, from a criminal point of view.

One might ask the question whether of not it is possible that virtually any person can commit such a crime, if the access on board a ship, excepting of course the crew, is permitted under strict conditions, stated by law, and consequently, a non-crew person should not be in the situation where they might take control of a ship.

However, by including the term „without righ", the legislative body had in mind that any measures of taking over the control of a ship can constitude the material element, and thusly, there is no distinction between active subjects.

And so, the answer comes from the legislative body itself, meaning that any person that is responsible for their criminal actions can be the active subject of the crime.

- The passive subject

In this crime, the main passive subject is the state, as the embodiment of the fundamental social values that relate to the concept of civil naval safety, and also, as the only entity that can legislate and control the civil navigation.

The secondary passive subject of the crime can be a physical or judicial person if any harm comes to pass as a result of the crime.

3. THE OBJECTIVE SIDE

3.1 The material element

In its base form, found in article 13 paragraph 1 of Law no 191/2003 [2], the material element is stated as being „the act of taking over without right of the control or command of the ship".

And so, the material element represent a set of alternative elements, that have two normative modalities, - the taking over of control of the ship, and of its command.

Legally, the command of the ship or its control reside within the attributes of the crew or abiliated personell, and their representative being the commander.

The act of taking itself represents an action of handling the ship by those abilitated, in order to maintain conditions of the ship so that it may continue to sail or that it may land.

The command of the ship is legally and usually exercised on the bridge of the ship, in the superior part, in a higher position, that is suggestively called „ship's command".

The command function is one of the commander's, legally, or it belongs to the abilitated personell, that can replace the commander.

In order to fulfill such a command, the act of control of the ship is a part of it, representing a permanent surveillance of the navigational commands, and also the tehnical systems, that are used for safe sailing.

And such, the act of taking over control or command of a ship represents the sytuation where all command functions have been transfered from their rightful owner to unabilitated persons. That means that the ship must be itself ready to sail or to be already sailing, because if the ship is not in those two situations, we are not in the presence of a crime.

The material element states that the command must be obtained totally, and another requirement must be fulfilled – it must be done without a right, meaning it must be done outside of the law, so that the act is a crime.

3.2 The immediate consequence

The immediate consequence of the crime found in article 13 represents a state of danger for the safety of the ship and the safety of navigation, and and implicitly, the rules of sailing are broken, a fact that leads to the posibility of an incident during sailing.

3.2 The causality connection

The crime is one that causes a state of danger, and such the moment when the material element – the act of taking over control – is commited, a state of danger is created, so the causality results ex re.

4. THE SUBJECTIVE SIDE

The subjective element from the subjective side is commited with intention, in both forms, both direct and indirect.

The codified form of this crime has no condition required then it comes to motive, or related to purpose, but if these elements exist, they will be taken into consideration when the saction is individualised.

From this particular point of view, in the form found in article 13 paragraph 1, participation is possible in all forms, but in the case of co-authorship of the crime, all said co-authors must participate in the taking over of control or command.

5. CONSSUMATION

The crime is conssumed when act of taking over is realised, such a crime being of the continuous type.

If we are in the presence of several actions, based in multiple criminal resolutions, it is obvious we would be in the presence of different crimes.

The attempt when it comes to such a crime is possible in the case of article 13 paragraph 1 and is punishable under the law.

5. SANCTIONS

The crime is sanctioned with jail, from 2 to 7 years and the forbiddance of certain rights.

6. AGGRAVATED FORMS

According to article 16 of Law no 191/2003, „(1).The acts found in article 13, article 14 paragraph (1) and article 15, that were commited with the purpose of deviation of the ship from its course represent crimes and are punishable with jail from 3 to 10 years and the forbiddance of certain rights.

(2) The damaging of a ship, with the purpose found in article (1), is punishable by jail from 5 to 12 years and the forbiddance of certain rights. ”

The first aggravated form of the crime found in article 16 paragraph 1 states that the act of taking over control or command of a ship, if it is done with the purpose of deviation of said ship from its itinerary, constitutes an aggravated form of crime. We can see that this form is different from the base form, in that the subjective element preordaines the direct intention, qualified through purpose, because the criminal, by taking over the control has in mind the act of deviation from its itinerary of the ship. Such a deviation means that the perpetrator sways the ship from its course, its previous path of reaching a destination [3]. The conssumation is realised when the act of taking over is realised.

The aggravated crime existes even if the purpose is not realised. The sanction is jail between 3 to 10 years.

The second form of the aggravated crime is found in article 16 paragraph 2, and it states that the act of taking over the ship leads to the damaging of the ship, with the purpose of deviation from its route.

The damaging of the ship represents the causing of damage to the body of the ship, having as consequence the lack of adequate sailing.

The same type of direct intention is found in this aggravated form, with the condition of existance of the purpose of deviation from its route.

The sanction is jail from 5 to 12 years and the forbiddance of certain rights.

The third form of aggravated crime is found in article 19 of Law 191/2003, that states that „ If the acts found in article 13-17 caused extremely hard consequence, the crime is jail from 7 to 15 years and the forbiddance of certain rights.”

Qualification of the base form is as such realised by the more drastic result, that can produce a set of consequences, with a high degree of repercusion, a material damage of over 2.000.000 RON [4].

Commiting such an act has as form of guilt praeter intentionem.

The conssumation of this crime happens in the moment when the consequences happen (either damages to the ship, the destruction of the ship, accidents, and others). Depending of the consequences, we may find ourselves in the presence of other crimes as well.

As sanctions, this aggravated form has detention from 7 to 15 years and the forbiddance of certain rights.

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SQUAT ANALYSIS OF AN INLAND PASSENGER VESSEL

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ABSTRACT

The evaluation of the squat performance in the initial design stage constitutes an important aspect of ship safety. The present paper deals with some practical methods used to compute the ship sinkage and trim, in critical conditions. It also describes the new PHP-Squat computer code, developed in the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati, in order to calculate sinkage, depending on the ship speed and the depth to draught ratio. A practical evaluation of the squat performance of an inland passenger vessel in shallow water conditions is analyzed and the main conclusions are discussed. The new computer code is implemented into the global PHP (Preliminary Hydrodynamics Performance) software platform and may be used in both teaching numerical applications and research activities in the initial ship design process.

Keywords: *squat, computer code, inland passenger vessel.*

1. INTRODUCTION

When a ship operates at a given speed in still water, it generates its own waves. The wave generation process is concentrated in domains with strong curvature, where the local pressures are different from the environment. The most typical locations are the bow part of the ship, the forward and aft shoulders, and the stern part. A wave crest due to the higher pressure at the stagnation point will be generated at the bow part. Also, a through wave occurs due to the low pressure region on the shoulders, and a wave crest is generated on the stern by the pressure recovery. The additional buoyancy force in the bow and stern parts of the ship will be weighted out by the loss of buoyancy over most of the ship length. As a consequence, the trim and sinkage of the ship will be modified. The combined effect of the sinkage and trim (squat) is increased in shallow water conditions,

$$h/T = 1.2 - 1.5 \tag{1}$$

where h is water depth notation and T is ship draught.

The Froude number based on the water depth Fn_h may be defined by means of relation [2]

$$Fn_h = \frac{v}{\sqrt{g \times h}} \tag{2}$$

where v is the ship speed and g is the gravity acceleration. The critical condition in the shallow water domain is

$$Fn_h = 1 \tag{3}$$

and the critical speed may be determined by means of the relation

$$v_{cr} = \sqrt{g \times h} \tag{4}$$

The critical speed is associated with a dominant transverse wave system. As a consequence, the wave resistance component will be higher and the manoeuvring performance will decrease. Figure 1 shows the influence of the Froude depth number Fn_h on the non-dimensional sinkage and the trim angle [1]. The non-dimensional sinkage is calculated on the basis of the ship length. Close to the critical value given by relation (3), the ship substantially changes the trim and sinkage characteristics. Consequently, the squat computation is necessary, in order to keep the ship safe.

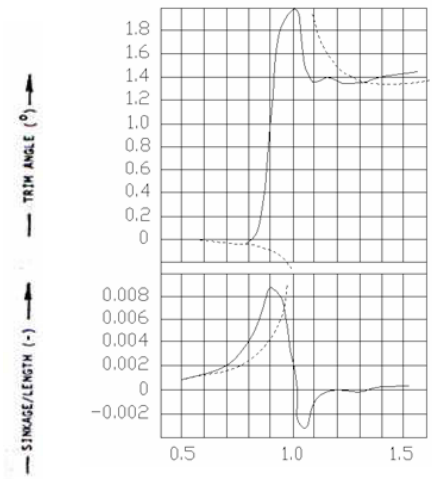

Figure 1 Influence of Froude depth number Fn_h on sinkage and trim angle

2. SQUAT COMPUTATION

Several authors proposed practical methods for calculating the midship sinkage s_m, the sinkage of the stern s_{AP}, the sinkage of the bow s_{FP} and the ship trim t ([1], [2]):

- Soukhomel and Zass

- if $h/T \geq 1.4$

$$s_m = 12.96 \times k \times \sqrt{\frac{T}{h}} v^2 \tag{5}$$

- if $h/T < 1.4$

$$s_m = 12.96 \times k \times v^2 \quad (6)$$

where, if $3.5 \le \frac{L_{pp}}{B} \le 9$

$$k = 0.0143 \times \left(\frac{L_{pp}}{B}\right)^{-1,11} \quad (7)$$

(L_{pp} is the length between the perpendiculars and B is the ship breadth);

- in the case of a slender ship

- if $3.5 \le \frac{L_{pp}}{B} < 5$

$$s_{AP} = 1.5 \times s_m \quad (8)$$

- if $5 \le \frac{L_{pp}}{B} < 7$

$$s_{AP} = 1.25 \times s_m \quad (9)$$

- if $7 \le \frac{L_{pp}}{B} \le 9$

$$s_{AP} = 1.1 \times s_m \quad (10)$$

- Hooft

$$s_m = C_z \frac{\nabla}{L_{pp}^2} \times \frac{F_{n_h}^2}{\sqrt{1 - F_{n_h}^2}} \quad (11)$$

$$t = C_\theta \frac{\nabla}{L_{pp}^2} \times \frac{F_{n_h}^2}{\sqrt{1 - F_{n_h}^2}} \quad (12)$$

where ∇ is volumetric displacement, the coefficient $C_z = 1.4...1.53$ and $C_\theta = 1$ (for different body lines forms);

- Barrass

$$z_{FP_{\max}} = C_B \times \left(\frac{v}{10}\right)^2 \quad (13)$$

where C_B is the block coefficient;

- Millward

$$z_{FP_{\max}} = \left(15 \times C_B \times \frac{B}{L_{WL}} - 0.55\right) \times \frac{F_{n_h}^2}{1 - 0.9 \times F_{n_h}} \times \frac{L_{WL}}{100} \quad (14)$$

where L_{WL} is the length of the waterplane;

- in the case of the minimum Froude depth number (Fn_h<0.1)

$$z_{FP_{\max}} = \left(C_B \times \frac{B}{2.6 \times T} - \frac{L_{WL}}{70 \times T}\right) \times \left(\frac{v}{10}\right)^2 \quad (15)$$

The relations mentioned above may be used in order to estimate the squat in the initial ship design stage.

3. PRACTICAL EVALUATION

A new PHP-Squat computer code was developed in the Research Centre of the Naval Architecture Faculty, in order to evaluate the ship squat, based on the previous formula ([3], [4]).

The input data module comprises the main characteristics of the ship shown in Table 1, the water depth to draught ratio h/T and the ship speed.

The computation module provides the bow sinkage, on applying the Millward and Barrass relations, and also the relation for the case of minimum the Froude depth number (15). The output data module yields the specific results.

A practical evaluation of the squat performance of an inland passenger vessel is presented in this chapter.

The main characteristics of the ship are shown in Table 1. The depth to draught ratio h/T was selected in the domain 1.2-3.0 (see Table 2) and the ship speed between 2-5 Kn, with an increment of 1 Kn.

Table 1. Main characteristics of the ship

Ship characteristics	**Value**
Length of waterline, L_{WL}	25.8 m
Length between perpendiculars, L_{pp}	25.0 m
Breadth, B	6.7 m
Mean draught, T	1.5 m
Block coefficient, C_B	0.5
Volumetric displacement, ∇	140 m^3

Table 2. Depth to draught ratio h/T

h/T				
1.2	1.5	2.0	2.5	3.0

Figure 2 shows the increase of the bow sinkage versus the ship speed, obtained on the basis of the Barrass relation (13).

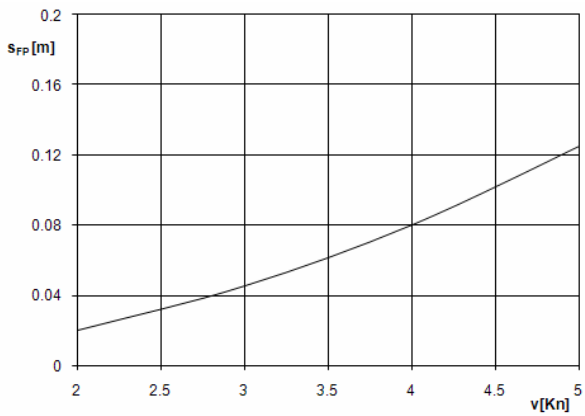

Figure 2 Bow sinkage
(according to the Barrass relation)

Figure 3 shows the influence of the speed on bow sinkage, for a constant h/T ratio, determined by using the Millward relation (14). Increases in ship speed yield higher values of the bow sinkage.

Also, Figure 4 shows the influence of the h/T ratio on bow sinkage, at constant speed, on the basis of the same relation.

It may be noted that the bow sinkage increases in shallow water conditions, when the depth to draught ratio h/T decreases.

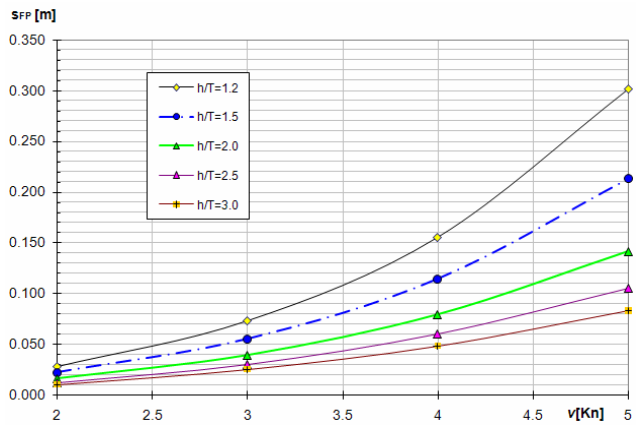

Figure 3 Bow sinkage versus ship speed, for constant h/T values (according to the Millward relation)

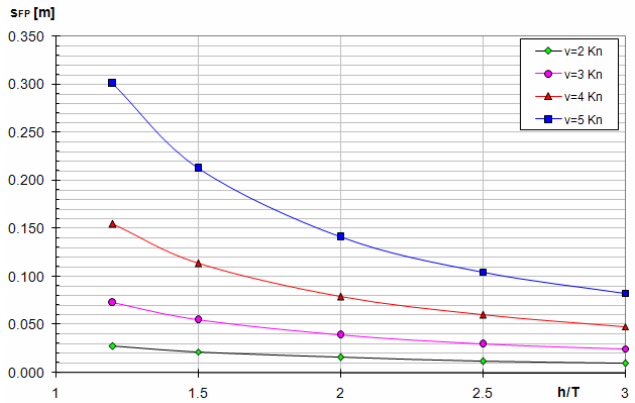

Figure 4 Bow sinkage versus h/T ratio, for constant speed values (according to the Millward relation)

Figure 5 shows the influence of the speed on the ship trim t, measured in [m], at a constant h/T ratio, determined by using the Hooft relation (12). When the ship speed increases, higher values of the trim will be obtained.

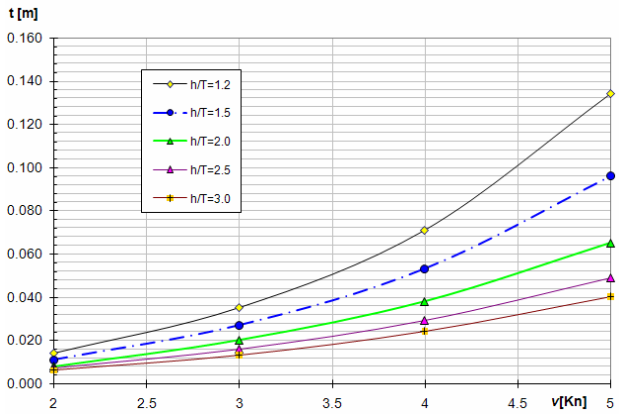

Figure 5 Trim versus ship speed, for constant h/T values (according to the Hooft relation)

Figure 6 shows the influence of the h/T ratio on the ship trim, for constant speed values, on the basis of the same relation. The ship trim t increases in shallow water conditions, when the depth to draught ratio h/T decreases.

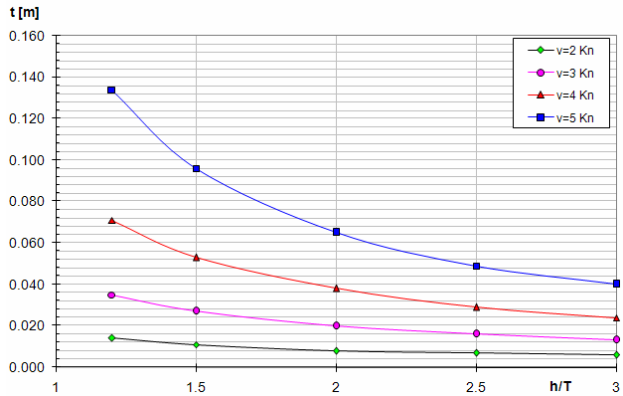

Figure 6 Trim versus h/T ratio, for constant speed values (according to the Hooft relation)

Figure 7 shows the influence of the speed on the midship sinkage, at a constant h/T ratio, determined by using the Hooft relation (11), where C_z=1.5. When the ship speed increases, higher values of the midship sinkage will be obtained.

Similarly, Figure 8 shows the influence of the h/T ratio on the midship sinkage, at constant speed, on the basis of the same relation.

It may be observed that the midship sinkage increases in shallow water conditions, when the depth to draught ratio h/T decreases.

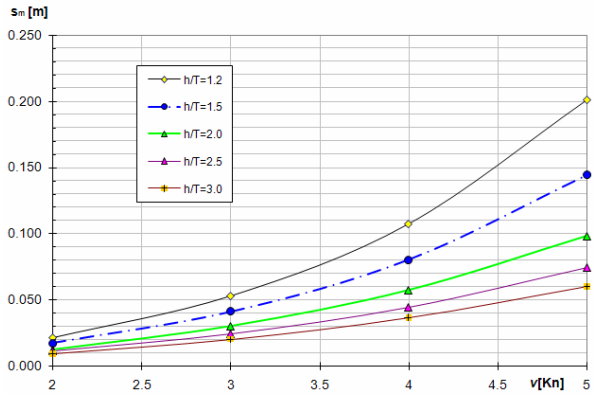

Figure 7 Midship sinkage versus ship speed, for constant h/T values (according to the Hooft relation)

Figure 9 shows the influence of the speed on the stern sinkage, at a constant h/T ratio, determined by means of relation (8). The growth of the ship speed determines the larger values of the stern sinkage.

Also, Figure 10 shows the influence of the h/T ratio on stern sinkage, at constant speed, on the basis of the same relation.

It may be said that the stern sinkage increases in shallow water conditions, when the depth to draught ratio h/T decreases.

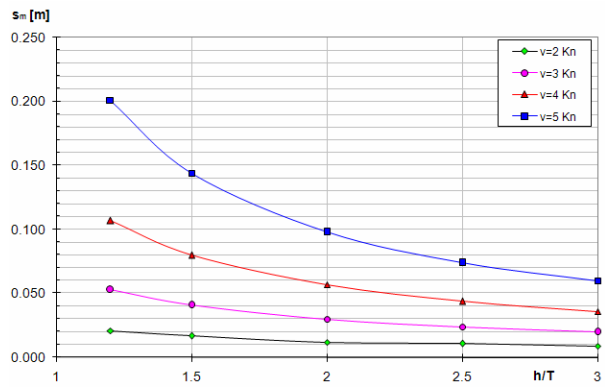

Figure 8 Midship sinkage versus h/T ratio, for constant speed values, according to the Hooft relation

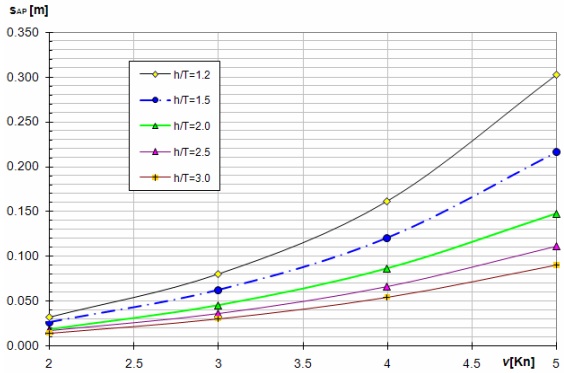

Figure 9 Stern sinkage versus ship speed, for constant h/T values, according to relation (8)

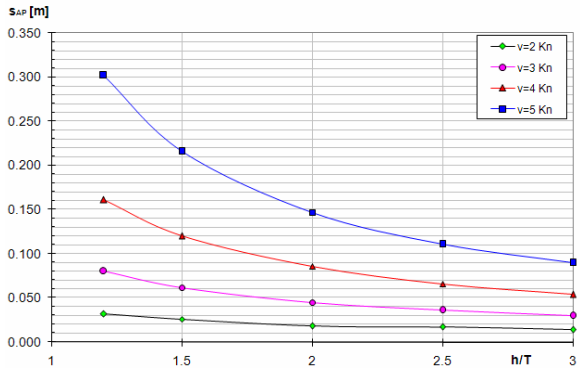

Figure 10 Stern sinkage versus h/T ratio, for constant speed values, according to relation (8)

4. CONCLUSIONS

The estimation of the squat in shallow water conditions in the preliminary design stage is an important issue, related to ship safety.

Practical relations may be used in order to determine the sinkage and trim, especially in critical conditions, when the Froude depth number is close to 1.

In this context, a new computer code was developed in the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati, in order to calculate the squat, depending on the ship speed and the depth to draught ratio h/T.

A practical evaluation of the squat performance of an inland passenger vessel in shallow water conditions was presented. This analysis reveals the increase of the sinkage and trim, when the ship speed increases and the depth to draught ratio h/T decreases.

The PHP-Squat computer code was included in the global PHP (Preliminary Hydrodynamics Performances) software platform, developed by the Naval Architecture Faculty.

This numerical platform is used in both teaching applications and research activities involved in the initial ship design stage, in order to estimate the most important hydrodynamics performance related to ship resistance, propulsion and manoeuvrability.

5. ACKNOWLEDGMENTS

The research was supported by the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati.

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SMALL SHIP RESISTANCE ESTIMATION IN DISPLACEMENT AND TRANSIENT DOMAIN

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ABSTRACT

The evaluation of the small ship resistance is one of the most important problems of hydrodynamics in the initial design stage. The present paper deals with a practical method used to estimate the small ship resistance, in the displacement and transient domain. The new PHP-NM-RI-DT computer code, developed in the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati was described and used in order to calculate the resistance performance of a small ship, with 9.2 m in length. The components of the small ship resistance were evaluated and a comparative analysis was performed. The new computer code was implemented into the global PHP (Preliminary Hydrodynamics Performance) software platform and may be applied in the initial design process of small ships.

Keywords: *resistance, small ships, displacement/transient domain.*

1. INTRODUCTION

Small ship resistance is one of the most important hydrodynamic performances. The theoretical methods used in order to estimate small ship resistance depend on both the ship's operating mode (displacement, transient or planning domain) and the number of hulls.

The operating mode may be set according to the value of the Froude number Fn_∇, defined on the basis of the volumetric displacement ∇ and the ship speed v, by means of the relation

$$Fn_\nabla = \frac{v}{\sqrt{g \times \nabla^{1/3}}} \tag{1}$$

where g is the gravitational acceleration.

The following operating modes may be established:

- Displacement domain, if $Fn_\nabla < 1$;
- Transient domain, if $1 < Fn_\nabla < 3$;
- Planing domain, if $Fn_\nabla > 3$.

The method described in this paper refers to small ship resistance estimation, of the monohull type, in the displacement or transient domain. In this case, the *total small ship resistance* R_T may be determined by using the relation ([1], [2])

$$R_T = R + R_{APP} + R_A \tag{2}$$

where R is the bare hull resistance, R_{APP} is the appendage resistance and R_A is the aerodynamic resistance. In the next chapter, the components of the total resistance will be calculated, on the basis of references ([1], [2]).

2. SMALL SHIP RESISTANCE COMPONENTS

The *bare hull resistance* is computed by means of the relation ([1], [2])

$$R = R_F + R_{PV} + R_W \tag{3}$$

where R_F is frictional resistance, R_{PV} is the viscous pressure resistance and R_W is own wave resistance.

The *frictional resistance* is found by the relation

$$R_F = \left(C_{F_0} + \Delta C_F\right) \times \frac{\rho \times v^2}{2} \times S \tag{4}$$

where, C_{F_0} is the frictional resistance coefficient, ΔC_F is an additional coefficient due to the roughness of the hull and holes ([1], [2]), ρ is the water density and S is the wetted surface area of the small ship without appendages.

The frictional resistance coefficient is determined on the basis of the ITTC 1957 formula

$$C_{F_0} = \frac{0{,}075}{\left(\log \mathrm{Re} - 2\right)^2} \tag{5}$$

Or the Prandtl-Schlichting expression

$$C_{F_0} = \frac{0{,}455}{\left(\log \mathrm{Re}\right)^{2{,}58}} \tag{6}$$

depending on the Reynolds number

$$Re = \frac{v \times L_{WL}}{\upsilon} \tag{7}$$

where L_{WL} is the length of the waterline and ν is the kinematic viscosity of the water.

The *viscous pressure resistance* may be determined by the expression

$$R_{PV} = R_F \times (\eta - 1) \tag{8}$$

where η is a viscous pressure resistance coefficient, depending on the prismatic coefficient C_P and the ratios $L_{WL}/\nabla^{1/3}$, B/T and L_K/L_{WL} ([1], [2]). B is the breadth of the small ship, T is the medium draught and L_K is the distance measured from the aft part of the ship to the aft transverse section of the ship's cylindrical domain.

The *own wave resistance* is calculated by means of the Papmel relations, depending on the critical ship speeds v_1 and v_2:

- if $v>v_2$,

$$R_W = 20 \times k \times \frac{g \cdot \Delta}{L_{WL} \cdot 10^3} \cdot v_2^{\,2} \cdot (v/v_2)^{1/2} \tag{9}$$

- if $v_1<v<v_2$,

$$R_W = C_{B0} \cdot k \times \frac{g \cdot \Delta}{L_{WL} \cdot 10^3} \cdot v^{\,2} \tag{10}$$

where Δ is the small ship displacement and the critical ship speeds are given by the following relations

$$\begin{aligned} v_1 &= 0{,}6 \cdot \sqrt{L^*} \\ v_2 &= 1{,}6 \cdot \sqrt{L^*} \\ L^* &= x \cdot L_{WL} \end{aligned} \tag{11}$$

The coefficients C_{B0}=f(Fn) and x=f(k) may be evaluated on the basis of references ([1], [2]), where the Froude number is given by the expression

$$Fn = \frac{v}{\sqrt{g \cdot L_{WL}}} \tag{12}$$

and the coefficient k is defined by formula

$$k = 10 \cdot C_B \cdot B / L_{WL} \tag{13}$$

The *appendage resistance* is computed by means of the expression

$$R_{APP} = k_{APP} \cdot R \tag{14}$$

where the coefficient k_{APP} depends on the complexity of the appendages and the Froude numbers (Fn, Fn_∇).

The *aerodynamic resistance* may be calculated using the relation

$$R_A = C_A \cdot \frac{\rho_a \cdot (v + v_v)^2}{2} \cdot S_e \tag{15}$$

where C_A is the aerodynamic coefficient, ρ_a is the air density, v_v is the wind speed and S_e is the aerodynamic surface area (projected on the midship section).

On the basis of this theoretical model, the computer code PHP-NM-RI-DT was developed at the Research Centre of the Naval Architecture of "Dunarea de Jos" University of Galati, in order to obtain quick practical evaluations of the small ship resistance, of the monohull type, in the displacement and transient domain ([3], [4]). A practical application is exemplified in the next chapter.

3. PRACTICAL EVALUATION

This section deals with resistance evaluation of a small ship with 9.2 m in length, running in fresh water. The main characteristics of the small ship are provided in Table 1. The wind speed was considered to be v_v=8 m/s and the aerodynamic coefficient was selected with the value C_A=0.5. The appendage resistance was calculated using the following relation

$$R_{APP} = 0.07 \cdot R\,. \tag{16}$$

Table 1. Main characteristics of the small ship

Ship characteristics	Value
Length of waterline, L_{WL}	9.2 m
Length between the aft part of the ship and the aft transverse section of the ship's cylindrical domain, L_K	0 (without cylindrical domain)
Breadth, B	2.2 m
Mean draught, T	0.6 m
Volumetric displacement, ∇	4.6 m^3
Wetted surface area (bare hull), S	19.5 m^2
Aerodynamic surface area, S_e	5.5 m^2
Block coefficient, C_B	0.420
Midship section coefficient, C_M	0.803
Design speed, v	13.4 Kn

The input data module of the computer code comprises the main characteristics of the small ship shown in Table 1 and at the beginning of this chapter.

The figures 1-5 show the diagrams of the small ship resistance components (frictional, viscous pressure, wave, appendage, aerodynamic), and Figure 6 shows the diagram of the total resistance.

Comparative diagrams of the bare hull resistance components, according to relation (3) are shown in Figure 7, and the total resistance components, according to relation (2) are shown in Figure 8. The diagrams have the ship speed on the abscissa.

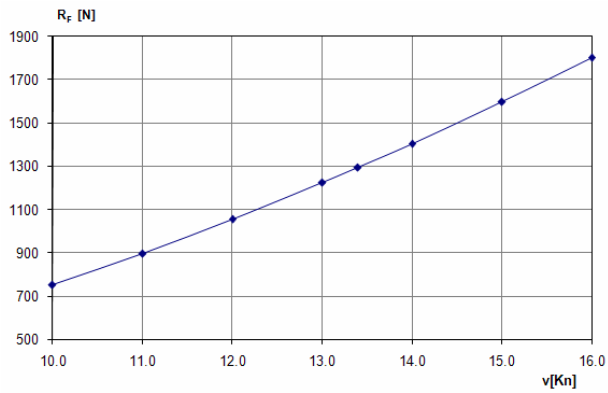

Figure 1 Frictional resistance diagram

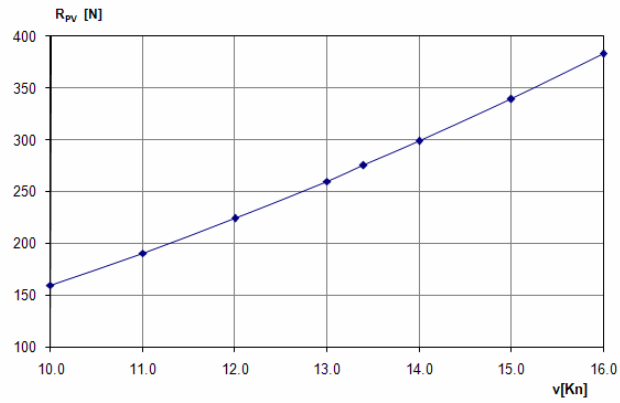

Figure 2 Viscous pressure resistance diagram

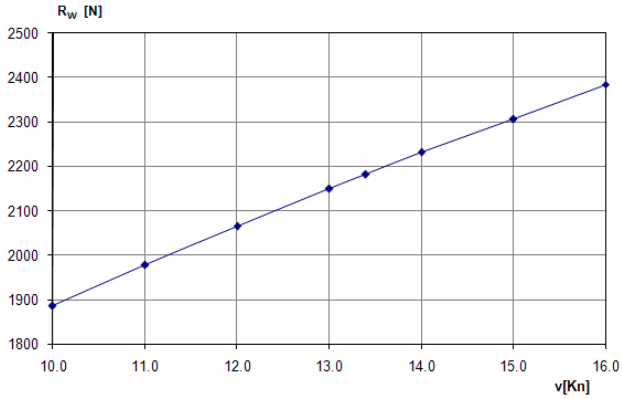

Figure 3 Own wave resistance diagram

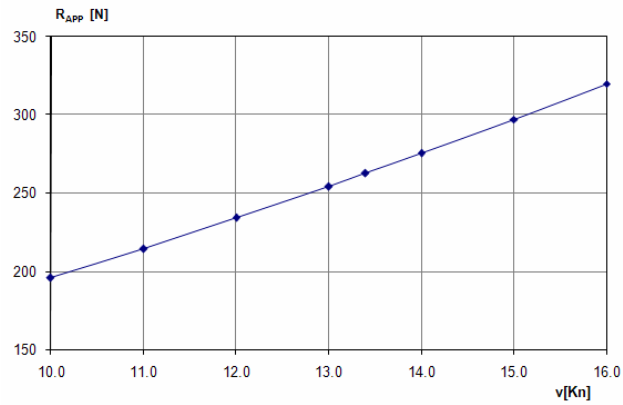

Figure 4 Appendage resistance diagram

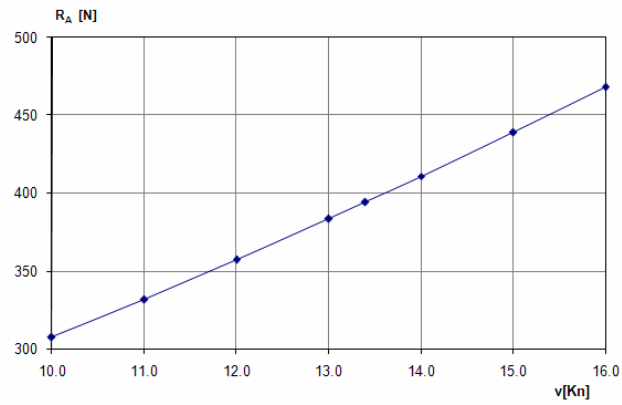

Figure 5 Aerodynamic resistance diagram

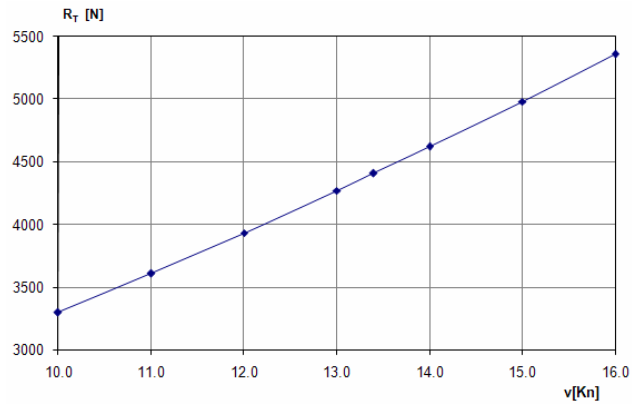

Figure 6 Total resistance diagram

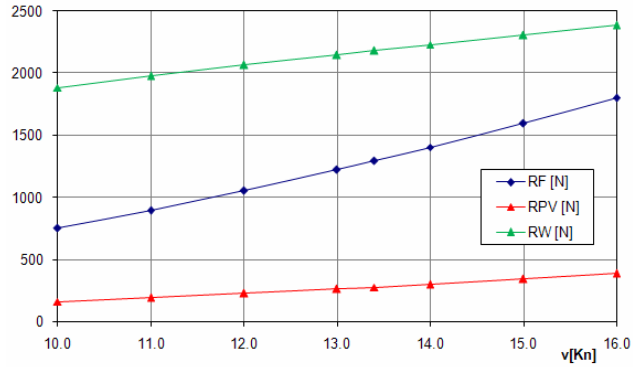

Figure 7 Bare hull resistance components

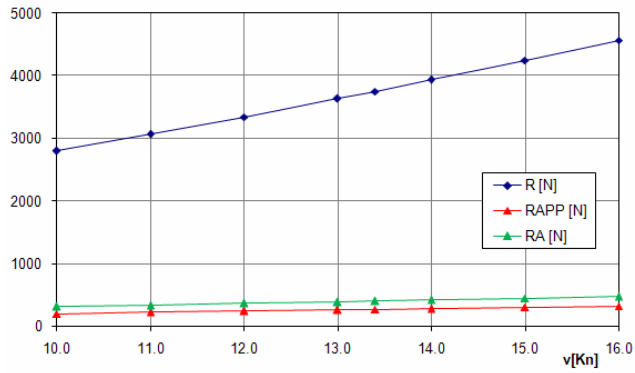

Figure 8 Total resistance components

The following observations may be noted:

- all the resistance components and also the total small ship resistance increase with ship speed, all the curves being monotones (without local maximum values);
- the most important components are the own wave resistance and the frictional resistance;
- the small ship analysed has important problems related to the own wave resistance, since at design speed the following values of the below ratios are registered

$$\frac{R_W}{R_F} = 1.687; \frac{R_W}{R_T} = 0.495 \qquad (17)$$

- due to the wind speed influence, the aerodynamic resistance is greater than viscous pressure resistance or the appendage resistance;
- the below ratio demonstrates the contribution of viscous

pressure resistance to design speed

$$\frac{R_{PV}}{R_F} = 0.213 \quad (18)$$

4. CONCLUSIONS

The evaluation of the small ship resistance represents one of the most important problems related to hydrodynamics in the initial design stage.

The present paper deals with a practical method used to estimate the small ship resistance of the monohull, in the displacement and the transient domain.

The total resistance includes the bare hull resistance, the appendage resistance and the aerodynamic resistance. Also, the bare hull resistance is calculated by summing the frictional resistance, the viscous pressure resistance and the own wave resistance.

By means of the Mordvinov method, a new computer code was developed in the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati.

A practical evaluation of the resistance performance in the case of a small ship, with 9.2 m in length, was used as an example. The components of the small ship resistance were evaluated. The comparative analysis reveals a high value of the own wave resistance. As a consequence, a numerical CFD investigation in order to reduce this resistance component must be applied in the future.

The new computer code was implemented into the global PHP (Preliminary Hydrodynamics Performance) software platform, developed in the Research Centre of the Naval Architecture Faculty and dedicated to the initial design process of ships, including small vessels. This numerical platform is also used in teaching applications related to the estimation of the ship resistance, propulsion and manoeuvring performance.

5. ACKNOWLEDGMENTS

The research was supported by the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati.

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TRIM INFLUENCE ON HYDRODYNAMIC RESISTANCE OF A SAILING BOAT

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ABSTRACT

The study of sailboat hydrodynamic resistance is an important issue, in evaluation of the navigation performances. The present paper investigates the initial trim influence on the hydrodynamic resistance component, using the experimental facilities of the Research Centre of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati. Experimental model tests were performed on a competition sailing boat model, of about 1.3 m in length, in two different conditions: with and without initial trim. The experimental analysis is drawing the attention to the influence of the initial trim, on one hand and of the appendages on the other hand, on the hydrodynamic resistance in calm water.

Keywords: *hydrodynamic resistance, sailing boat, model test, trim, appendages.*

1. INTRODUCTION

The hydrodynamic characteristics of sailing boats could become of paramount importance when the navigation performances have to be investigated. In present paper, the influence of the initial trim on the hydrodynamic resistance performance of a competition sailboat model was investigated by means of experimental tests performed in the Towing Tank of "Dunarea de Jos" University of Galați. Photo 1 shows the towing tank and the modern carriage with maximum speed of 4 m/s, manufactured by Cussons Company in U.K. The main dimensions of the towing tank are 45 m x 4 m x 3 m.

Photo 1 Towing tank in "Dunarea de Jos" University of Galați

Although the resistance performance may be estimated on the basis of theoretical methods [1], the experimental model tests are commonly used to validate the numerical results, or to study some complex hydrodynamics phenomena [2], [3].

The experimental model is shown in Photo 2 and the main dimensions are presented in Table 1. The model includes the bare hull, the keel, the suspended rudder with a large aspect ratio, and an additional weight fixed on the keel.

The experimental model tests, with and without initial trim, were performed in the Galati University Towing Tank, using the ITTC Recommended Procedures [4].

The wave pattern was recorded and analysed. During the experimental tests, the model trim was unrestricted, but the sinkage was kept blocked. The model resistance R_m, the trim angle $\square_m$ (+ aft immersion) and the carriage speed v_m were measured during the experiment.

Photo 2 Experimental model

Table 1. Main dimensions of sailing boat model

Main characteristics	Experimental model
Length overall, L_{OA} [m]	1.360
Length between perpendiculars, L_{BP} [m]	1.300
Maximum breadth, B_{max} [m]	0.200
Depth, D [m]	0.118
Height of keel, H_K [m]	0.587
Medium chord of keel, c_K [m]	0.086
Length of additional weight, L_{AW} [m]	0.293
Diameter of additional weight, D_{AW} [m]	0.048
Height of the rudder, H_R [m]	0.254
Medium chord of the rudder, c_R [m]	0.070

The results of the experimental model tests without initial trim, with and without appendages, are investigated in the next chapter.

2. EXPERIMENTAL MODEL TESTS WITHOUT INITIAL TRIM

The characteristics of the model with appendages and without initial trim are shown in Table 2. The results of the experimental model tests are shown in Table 3. It can be observed that the values of the trim angle and aft immersion increase with the model speed.

The model resistance diagram is presented in Figure 1. The dependence of the wave pattern with the increment of model's speed is shown in Photos 3-7.

Table 2. Main characteristics of the sailing boat model, with appendages, without initial trim

Main characteristics	Experimental model
Length of waterline, L_{WL} [m]	1.289
Breadth of waterline, B_{WL} [m]	0.165
Medium draught from base line, T [m]	0.045
Longitudinal centre of buoyancy (from AP), LCB [m]	0.629
Displacement, Δ [Kg]	4.578
Wetted surface of bare hull, S [m^2]	0.183
Wetted surface of appendages, S_{APP} [m^2]	0.129
Block coefficient, C_B	0.411
Midship section coefficient, C_M	0.743
Waterline coefficient, C_W	0.708

Table 3. Test results.
Model with appendages, without initial trim

v_m [m/s]	R_m[N]	θ_m [deg.]
0.5	0.429	0.07
1.0	1.699	-0.39
1.5	3.574	0.45
2.0	6.357	1.17
2.5	9.245	1.84

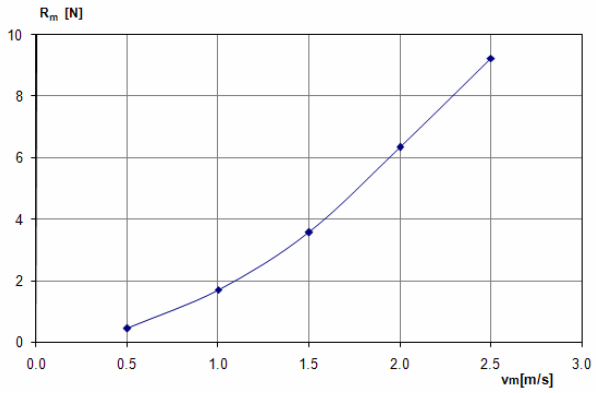

Figure 1 Resistance diagram.
Model with appendages, without initial trim

It has to be noticed that on the forward part of the model few vortexes can be observed, leading to some increase of the hydrodynamic resistance. Additionally, two significant oblique wave crests occur and can be identified alongside the model, at high speeds.

In order to determine the appendages' influence on the model resistance, a new set of tests was performed, using the bare hull at the same average draught.

The appendages resistance is the difference between the model resistance with appendages and the bare hull one.

Photo 3 Wave pattern, v_m=0.5 m/s

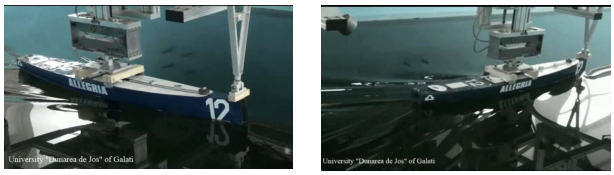

Photo 4 Wave pattern, v_m=1 m/s

Photo 5 Wave pattern, v_m=1.5 m/s

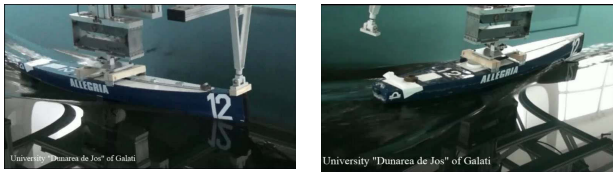

Photo 6 Wave pattern, v_m=2 m/s

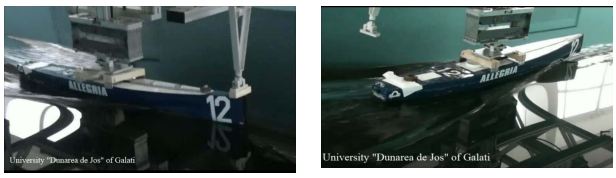

Photo 7 Wave pattern, v_m=2.5 m/s

The results of the experimental model tests using the bare hull model are shown in Table 4 and the model resistance diagram can be seen in Figure 2.

Table 4. Test results.
Bare hull model, without initial trim

v_m [m/s]	R_m [N]
0.5	0.084
1.0	0.666
1.5	1.896
2.0	3.729
2.5	5.209

The ratio R_{APPm}/R_m between the appendages resistance R_{APPm} and the model resistance is shown in Table 5, in the case without initial trim.

Figure 3 shows the resistance diagram of the model without initial trim, for the cases with and without appendages. The increase of the model resistance due to appendages is significant and become very important for real speed evaluation.

The results of the experimental model tests with initial trim and appendages are examined in the following chapter.

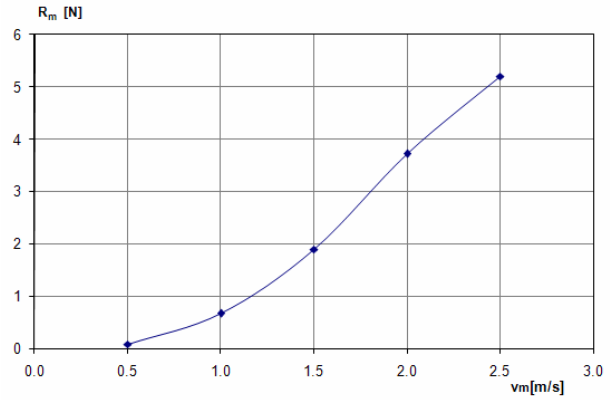

Figure 2 Resistance diagram.
Bare hull model, without initial trim

Table 5. Model without initial trim.
Influence of appendages resistance

v_m [m/s]	R_{APPm} [N]	R_{APPm}/R_m
0.5	0.345	0.804
1.0	1.033	0.608
1.5	1.678	0.470
2.0	2.628	0.413
2.5	4.036	0.437

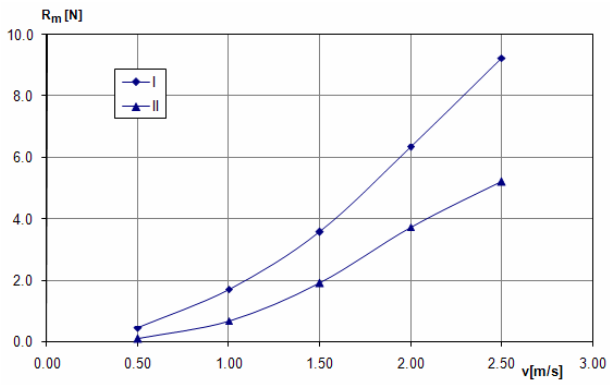

Figure 3 Resistance diagram. Model without initial trim
I - with appendages, II - without appendages

3. EXPERIMENTAL MODEL TESTS WITH INITIAL TRIM

The main characteristics of the model with appendages and initial trim are shown in Table 6, while the results of the experimental model tests are shown in Table 7. The trim angle (aft immersion) at constant speed is greater than the case without initial trim.

The model resistance diagram is shown in Figure 4.

Figure 5 shows the resistance diagram of the model with appendages, with and without initial trim. The values of model resistance with initial trim are lower when compared to the case without initial trim.

4. CONCLUSIONS

As previously mentioned, the determination of the hydrodynamic resistance of a sailing boat is an issue of utmost importance. The present paper examines the hydrodynamic component of the model's resistance.

The experimental model tests were carried out using the experimental facilities of the Towing Tank of the Naval Architecture Faculty of "Dunarea de Jos" University of Galati. The influence of the initial trim of a competition sailing boat model was investigated.

Table 6. Main characteristics of the sailing boat model, with appendages and initial trim

Main characteristics	Experimental model
Length of waterline, L_{WL} [m]	1.267
Breadth of waterline, B_{WL} [m]	0.166
Forward draught from base line, T_F [m]	0.034
Aft draught from base line, T_A [m]	0.055
Longitudinal centre of buoyancy (from AP), LCB [m]	0.580
Displacement, Δ [Kg]	4.578
Wetted surface of bare hull, S [m^2]	0.182
Wetted surface of appendages, S_{APP} [m^2]	0.129
Block coefficient, C_B	0.415
Midship section coefficient, C_M	0.745
Waterline coefficient, C_W	0.724

Table 7. Test results.
Model with appendages and initial trim

v_m [m/s]	R_m [N]	θ_m [deg.]
0.5	0.187	0.31
1.0	1.441	-0.03
1.5	3.170	0.95
2.0	5.876	1.51
2.5	8.251	2.05

The main components of the experimental model include the bare hull, a keel with an additional weight having a hydrodynamic form and a suspended rudder. The length between the perpendiculars of the model was 1.3 m.

On the basis of experimental results, the following observations may be made:

- the initial trim of the model could reach an important influence;
- the model resistance with initial trim has lower values as compared to those without initial trim;
- the percentage reduction, D [%], of the model resistance with trim, as compared to model resistance without trim, within the domain of the investigated speeds was placed in the range 7.6 % - 56.4 % (see Table 8);
- the analysis of the appendages' influence on the model resistance without trim is underlining the

important contribution of the keel with additional weight and of the rudder respectively (see Table 5).

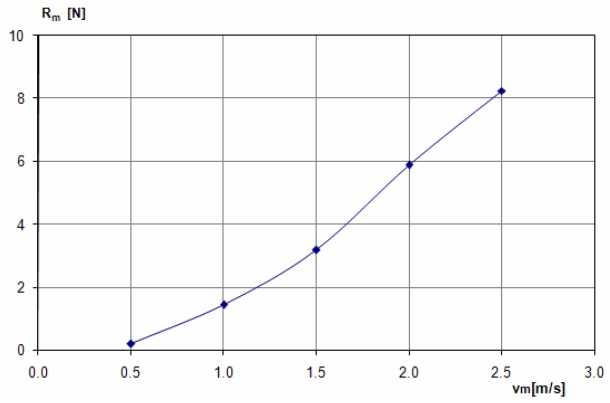

Figure 4 Resistance diagram.
Model with appendages and initial trim

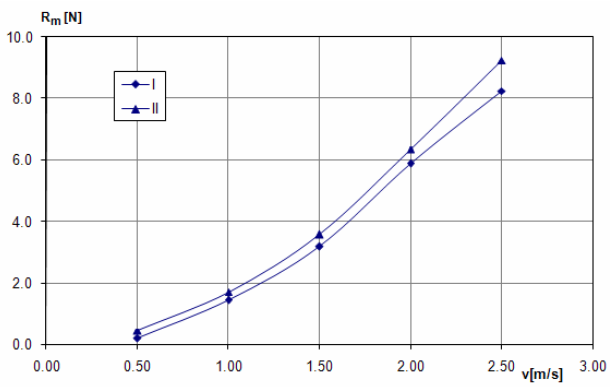

Figure 5 Resistance diagram. Model with appendages
I - with initial trim, II - without initial trim

Table 8. Percentage reduction
of the resistance, for the model with initial trim

v_m [m/s]	D [%]
0.5	56.4
1.0	15.2
1.5	11.3
2.0	7.6
2.5	10.8

Consequently, the experimental procedure described in this paper may be extended in order to determine an optimum initial trim, using the evaluation of the hydrodynamic model resistance criterion.

Mention should be made that a lower value of the resistance due to the appendages can be investigated by means of model tests, as far as the superposition principle can't be used anymore.

These approaches have to be correlated with the influences on stability, manoeuvrability and seakeeping performances.

Moreover, the aerodynamic resistance become relevant due to the exposed area, taking into account the high influences on the overall above navigability criteria.

5. ACKNOWLEDGMENTS

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The experimental tests were possible due to our friend, Dipl. Eng. Ion Ungureanu, to whom we are deeply grateful for providing the model of the competition sailing boat.

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CRIMES AGAINST ORDER AND DISCIPLINE ON BOARD OF SHIPS

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ABSTRACT

Taking into account the efforts made by Romania to integrate into the European Union structures, the transition to a market economy, benefiting from the support of the international organizations in the field, our Government has initiated the creation of drafts bills for carrying out shipments in normal conditions and aligning the Romanian legislation to the European one.

So, there have been adopted a series of laws that served for creating a climate of safety in civil navigation, such as the Ordinance no. 42/1997 on civil navigation amended by the Law no. 412/2002 and Ordinance no. 48/2003, the Decision no. 245/2003 for the approval of the Regulation of implementing the Government Ordinance on naval transport, the Decision no. 441/1995 for establishing and setting the appropriate punishments for the offences regarding the infringements of the rules of transportation on the national navigable waters and ports.

Keywords: *naval laws, naval transport, safety of the vessel, naval offences, civil navigation.*

1. INTRODUCTION

The offense of refusing to carry out an order regarding the official duties for the safety of navigation and of the vessel is regulated by the lawmaker as actionable negligence offence in article 23 paragraph 1 of the Law no. 191/2003, and as aggravated offence in article 23 paragraph 2 of the same law. In article 23 paragraph 1 is stipulated the actionable negligence form of the offense, namely: the refusal to execute an order regarding the official duties for the safety of navigation and of the ship.

The offense has as its special legal object the social relations on the discipline and order on board, involving the just and timely execution of orders of the superior officers regarding the official duties. This offense is a version of the offense of abuse of office against public interests stipulated in article 248 of the Criminal Code and is similar (The action of a public employee, who during the exercise of his duties, and being aware of his/her actions, does not comply with or improperly observe his/her duties and thus he/she causes a significant disturbance to the proper management of a state authority or institution or of any unit that is stipulated in article 15 or it causes a damage to its patrimony, shall be punished with imprisonment from 6 months to 5 years), almost identical with the insubordination offence, namely its basic version, as it is provided in article 334, paragraph 1 of the Criminal Code (The refusal to execute an order regarding the official duties is punishable by imprisonment from 6 months to 2 years. This type of offence has no material object).

The refusal to execute an order can be committed by any criminally liable person whose his/hers job duties concern safety of the ship and of navigation, so the active subject of this offence is a qualified subject (who can be a person that is part of the crew or who is responsible for its safety while dry docking). If the active subject of this offence is the master of the ship, the offense is more serious, according to paragraph 2 of the article 23. The passive subject is the State as holder of the protected social value (safety of the ship and / or of navigation).

As regarding the objective side of the offence, there should be a prerequisite condition consisting in giving an order. To be executed, the order must be received from a supervisor or a person vested by law with the right to give such orders or to be received from an appropriate authority and it must concern the necessity to take measures for the safety of navigation and must have a legal content and a legal form (it must be issued in compliance with the legal provisions)[1]. When the order is issued in violation of the law or if it is issued by an incompetent person or authority, it shall not generate the obligation of execution; therefore, the refusal to execute such an order shall not constitute an offence because no one can be held accountable for having refused the execution of an order which is against the legal provisions[2].

To fulfil the objective aspect of the offense, the order must relate to the official duties of the crew of a ship or of a person responsible for the safety of navigation while dry docking; otherwise this action is not an offence.

The provisions of the order must relate to the safety of the ship and of navigation or otherwise this action does not represent such an offence.

The offense is generated by the refusal to execute an order concerning official duties. The refusal means the action of not accepting something, not consenting to something, not wanting to do something. The order means a provision given by an authority or by an official person to other authority or to other person to be executed exactly as it is given. The refusal to execute the received order shall not constitute a more serious offense[3], this offense having an alternative character, namely that it will be taken into account only if the action does not contain the elements of a more serious

offense (for example, the offense stipulated in article 10 of the Law no. 191/2003).

We are not facing such an offense if the perpetrator previously refused to execute the order, but who carries it out in due time or if the given order, which has not been executed, has been withdrawn or if such an order is impossible to be carried out[4].

Execution of the order after its deadline is a mitigating circumstance which shall be taken into account while individualizing the punishment.

If several operations provided in the same order have not been executed, we are in the presence of a single offense, but if the perpetrator repeatedly refuses executing two or more orders given by the same authority or by different authorities, even if they refer to the same event, then we face a recurrent offense or real multiple offences if there are several criminal intentions[5].

The immediate result is the state of a real danger against the safety of the ship and of navigation. As the offense creates a state of danger, it is not necessary to prove the causal relation, this relation resulting from the substantially of the facts. The offence is committed with direct or indirect intention. The perpetrator is aware of the issued order made and although he/she could and should carry it out, he/she does not do it, pursuing or accepting the immediate result of the offence.

The attempt is not possible. The offense is instantly consumed when perpetrator, although being aware of the order given, refuses to execute it, thus being generated the dangerous consequence of the action. Taking part in this kind of crimes can mean abetment and complicity.

The refusal to execute an order on concerning the official duties regarding the safety of the ship and of navigation is punishable by imprisonment from 3 months to 2 years.

Pursuant to paragraph 2 of article 23 of the Law no. 191/2003, the offence is more serious if the action is committed by the master of the ship. The aggravated offense relates to the subject of the offence, which must be the master. If the one who refuses to execute an order concerning the official duties regarding the safety of navigation or of the ship is the master we are in the presence of an aggravated offense because the master must do everything possible to sail and take the ship safely[6] to the port of its destination. The aggravated form of the offense is punishable by imprisonment from 6 months to 3 years.

2. THE OFFENSE OF COMMON ASSAULT OF A SUPERVISOR BY A LOWER RANK CREW

The common assault offense of a supervisor by a lower rank crew member is regulated by the lawmaker pursuant to the provisions of the article 24 paragraph 1 of the Law no. 191/2003, namely its basic version and the aggravated forms are stipulated in the same article in paragraphs 2 and 3. This offense is a special form of the common assault criminal offence, stipulated in article 180 paragraph 1 of the Criminal Code and they resemble the offense of common assault or insulting a supervisor stipulated in article 335 paragraph 1 of the Criminal Code. Common assault or any violent actions causing physical pain are punished by imprisonment from one month to three months or by fine.

Thus, whenever the constitutive elements of the two different offences are observed there is no circumstance of multiple crimes but rather a cumulation of different legal provisions, in such being applicable the special legal provision, pursuant to the Latin adage specialia generalibus derogant.

The offense has as special legal object, namely the social relationships concerning the discipline and order on board involving a respectful and dignified attitude towards the supervisors.

The offense also has a secondary legal object consisting in the social relationships that protect the persons against violence which causes physical injuries, such offences are produced by inflicting violence.

In article 24 paragraph 1 is stipulated the basic form of the offense, "common assault of a supervisor by a lower rank crew member ". The offense always has a material object the body of the victim. The offense of common assault of a supervisor by a lower rank crew member can be committed only by a crew member (a criminally liable person) who has a lower rank than the injured party; thus we are in the presence of a qualified active subject.

According to article 32 of the Ordinance no. 42/1997 amended by Law no. 412/2002, in terms of hierarchy, the crew is divided as it follows: master; first officer; deck officers; chief engineer; engineer officers; other officers; certified personal: boatswain , fitter, helmsman, boat master, machinist's mate, electrician, pump man, fireman, motorman, sailor; supporting staff. The main passive subject is the state, and the secondary passive subject is a crew member who has a higher rank than that of the perpetrator, and thus secondary passive subject is also a qualified subject.

In its aggravated form the secondary passive subject must be master or him to be exercising his job duties.

Although the incriminating legal provisions do not specifically refer to the place of the offence, the doctrine refers to it as being the shipboard[7].

For the existence of objective aspect of the offence there must be committed an act of violence; the violence must be carried out on board of the civilian ship or in connection with an activity on board of the civilian ship; the violence must take place between the crew members of the same ship. In terms of the objective aspect, the offense is achieved by committing violent actions against a crew member by another lower rank crew member. Hitting a person means carrying out any kind of violence on the body of a person causing physical suffering to that person without causing injuries requiring medical care for healing.

The violence may be due to physical energy of the perpetrator (by direct application of a hit which can be applied with the palm, with the fist, with a hard object etc., the law making no indication to this effect) or due to other forces which he can generate (e.g. pitting a dog to bite the supervisor, oiling the stairs on which the victim slips and injures himself etc.); thus the violence can be the direct result of the action of the perpetrator or the indirect consequence of his actions (as in the second example)[8].

Also, the action may be committed, and using psychological means (e.g. the perpetrator can scare its supervisor in order to determine him to fall and injure himself), not only material means. The material element of the offense can be achieved both by an action but also by an omission even if the offense is a comissive crime (e.g. when the perpetrator, although having the obligation to warn his superiors not to enter into a room, not perform a specific action, intentional breach his obligation, so that his supervisor to undergo that injury).

The violence has to inflict physical suffering to the victim. These sufferings are presumed because the violence cannot be inflicted without physical suffering.

If the offense produces physical injuries or damages the health and the victim requires medical care for healing more than 20 days (period which is stipulated in article 180 paragraph 2 of the Criminal Code) or any of the consequences provided by article 182 of the Criminal Code or the victim's death, we are dealing with ideal type of multiple offences common assault against a supervisor by a lower rank crew member and, if applicable, with the offense provided by articles 181, 182 or 183 of the Criminal Code.

If the crew members have equal ranks, the criminal action shall not constitute the offense stipulated in article 24 of the Law no. 191/2003, but it refers to the offense provided in article 180 of the Criminal Code as the essential requirements of law are not met, namely the different ranks of the crew members.

Having two secondary legal objects the offense generates two dangerous consequences: a state of danger for the discipline and order on board and the physical suffering caused to the victim. This last result sets conditions for the danger created to the state of discipline and order on board. If the suffering inflicted upon the victim refer to moral sufferings, the constitutive elements of the crime are not observed (as there is missing the result required by law). Therefore, although material, the result is assumed, not being necessary to establish and prove its existence (any blow can cause physical suffering).

The causal link between the violent action and the outcome is obvious and it is assumed at the direct infliction of violence and it must be proved only when exercising indirect violence. The offense is committed with direct or indirect intent. At the time the offense has been committed, the perpetrator must have been aware that the person on which violence have been inflicted is his supervisor. If the perpetrator was confused about the position of the victim the criminal liability shall be determined according to article 180 of the Criminal Code (imprisonment from one month to three months or a fine for the basic version of the offence or imprisonment from 3 months to 2 years or a fine for the aggravated version).

Attempt is possible for this type of crime, but the law does not punish it. The offense is carried out after creating physical suffering to the victim. Criminal participation is possible in the form of abetment and complicity.

Regarding the extrapolation of the offence of common assault or insulting a supervisor provided by article 335 of the Criminal Code the association for committing a crime is not possible. The idea that I shall always support is that, in general, it can be determined with certainty which of the participants produced each of the result of their actions, so each will answer for their actions as authors.

The battery of the supervisor by a lower rank crew member is punishable by imprisonment from 3 months up to 2 years or by fining.

According to paragraph 2 of the article 24 of the Law no.191 / 2003 the offence is more serious if the action is committed against the ship's master[9].

The aggravated form refers to the passive subject of the crime who must be the master. It is only normal to have an aggravated form of the offence if the one against whom the criminal action is directed is the master, as he is the one who represents the authority on board of the ship. The aggravated form of the offense is punishable by imprisonment from 6 months to 2 years.

Pursuant to article 24 paragraph 3 of the Law no. 191/2003 the battery of a supervisor by a lower rank crew member is more serious if the master is actually performing his job duties; Performing the job duties means exercising a profession, occupation, position. According to these conditions the criminal action has a higher degree of social danger. This represents an aggravating form of the aggravating form first provided by the article 24 paragraph 2.

For the existence of this form the place where the offence takes places is irrelevant, it is essential that the passive subject to be in the line of duty, and the perpetrator to be aware or to could have been aware that the passive subject was performing his duties, thus according to article 28 paragraph 2 of the Criminal Code - "the circumstances that refers to the criminal action are reflecting on the participants only if they were aware of them or could have foreseen them." The aggravating form is punishable by imprisonment from 6 months to 3 years.

3. THE OFFENCE OF COOMON ASSAULT ON A LOWER RANK CREW MEMBER BY A SUPERVISOR

The offense of common assault on a lower rank crew member by a supervisor is regulated by the Law no. 191/2003 in article 24 paragraph 4 for the basic version, as the law does not stipulate any aggravating circumstances for this offense.

This offense is also a variant of the offence of common assault or other type of violence provided by article 180 paragraph 1 of the Criminal Code and is very similar to the offence of battery or insulting of a supervisor stipulated in article 336 paragraph 1 of the Criminal Code. The common assault or other type of violence causing suffering shall be punished with imprisonment from one month to three months or by fine. Battery of the lower rank crew member by a supervisor or by the hierarchical manager is punishable by imprisonment from one month to one year.

As in the case of the previous offense, the provisions of the law shall be applied if the constitutive elements of the two offenses are met.

The offense has as special juridical subject the social relationships regarding the order and discipline on board of the ships which exclude the use of any means of humiliating the lower rank crew member by a supervisor.

The secondary legal object is the social relationships concerning the health or the physical condition of the person. In the interest of maintaining the discipline and order on board, the lawmaker stipulated in article 24 paragraph 4 the "common assault of a crew member by another crew member".

The offense always has as material object the body of the person that was assaulted, a lower rank crew member[10].

The offense of assault of a lower rank crew member by a supervisor can only be committed by a higher rank crew member (with criminal liability) than the injured party; so we have a qualified active subject.

The main passive subject is the state, and the secondary passive subject is the crew member who has a lower rank than that of the perpetrator, and therefore the secondary passive subject is also a qualified subject.

The material element of the objective aspect of the offence is achieved by the battery of a crew member by another higher rank crew member.

If a supervisor assaults in the very same circumstances (time, place, etc.) several lower rank crew members, there will be a real multiple offence according to how many people were assaulted, and not a single recurrent offence because there are created as many criminal law juridical relation as many individuals have been harmed. If among the assaulted people there are both supervisors and lower rank crew members there will be no real multiple crimes among the criminal offences mentioned in article 23 paragraph 1 and article 24 paragraph 4 of the Law no. 191/2003.

If the offense is repeated in different circumstances (time, place) there is a recurrent offense (which runs out at the last committed act of violence) or there is real multiple crime, as there are one or more criminal intentions.

The offense is committed with direct or indirect intent. It is also necessary the offender to be aware of the lower rank of the assaulted crew member. If the perpetrator was mistook the rank of the victim, the criminal liability will be determined according to the provisions of article 180 of the Criminal Code.

When the offense is committed by fault there can be another type of crime (namely the one provided by article 184 - deliberate bodily injuries, or article 178 - manslaughter of the Criminal Code, as appropriate).

In the case of this offence, the law does not punish the attempt of committing the crime. The crime is completed when the supervisor hits the lower rank crew member. Criminal participation is possible in the form of abetment and complicity in committing the offence.

The assault of the lower rank member crew by a supervisor shall be punished by imprisonment from one month up to 1 year. The law does not provide any aggravating circumstances for this crime.

4. ILLUSTRATING EXAMPLE

In this case the indictment 1 / PMF / 1996 of the Prosecutor's Office attached to Constanta Tribunal was used to open the trial against the defendant Vasile Grosu for the offense provided by the article 119 of the Decree no. 443/1972. The defendant, an officer on the ship named Lapus, was charged with assaulting without reason Mr Crintea Daniel, a lower rank crew member on the same ship. Pursuant to the Criminal sentence no. 34 / MF / 1998 pronounced by Constanta County Court in the case no. 13 / MF / 1996, the defendant was sentenced to six months imprisonment[11].

5. CONCLUSIONS

After analysing the legislation on punishing the offences on board of the ships it can be concluded that the Romanian judicial practice in maritime law is poor as there are no specialized courts of law to operate courts autonomous with a material legal competence, which would mean that people could appear before them in case of dispute.

Due to the current legislative deficiencies, in most of the case the contracting parties enter into the charter agreements or transportation agreements a clause stating that in case of any dispute the jurisdiction for solving these cases is of a foreign court.

It is therefore correct to state that the legal provisions regarding these legal matters are poor and need improvement.

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SECTION II
MECHANICAL ENGINEERING AND ENVIRONM

VALIDATION OF LAMINATE RESISTANCE BY USING EXPERIMENTAL RESULTS OR RESULTS CALCULATED BY DIFFERENT AUTHORS

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ABSTRACT

Leisure vessels are made of composite materials and mainly, of fibre reinforced composite materials. The glass fibre is the main material used for the construction of leisure boats since the middle of the '60s. The glass fibre is the most often used reinforcing material but for performing vessels the carbon or aramid fibre is used. The composite materials have various advantages, such as: light weight, corrosion resistance, impact resistance, anti-vibration capability, low costs, and easiness of the construction process, maintenance and repairs. The composite materials are used more often both in civil and military marine for the production of submarines and surface vessels. The composite materials used for the boat construction, namely the fibre reinforced plastic materials, have 2 main components: the fibres and the matrix. The fibres secure the composite material resistance and stiffness while the matrix sustains the fibres, enabling the creation of some structural elements, protects the fibres from the environment actions, transfers the stresses between fibres etc. The matrix has a low resistance and stiffness. We are going to compare the results obtained with MATLAB program for the laminate resistance with the results obtained by other authors, with results obtained by direct measurement over the laminate and the results obtained by applying the finite element method. It will be observed that as an essential conclusion, there is a good conformity between all these results.

Keywords: *leisure vessel, laminate, resistance, finite element method.*

1. INTRODUCTION

The fibre reinforced composite materials are made of layers (lamina). In a lamina the fibres are set in a unidirectional manner or as a canvas.

The constitutive equation is the one of an orthotropic material and is defined by four material parameters: the elasticity modulus on the two main directions of the material, Poisson's coefficient and the shear modulus ($E_1, E_2, \nu_{12}, G_{12}$).

A lamina resistance and stiffness can be established by direct measurement or by calculation. In this paper both of them are presented. In order to determine these measures by the calculation method, the blending law and the Halpin – Tsai equations are introduced. By using the blending law, good values are obtained for the elasticity modulus on the fibres direction and for the Poisson coefficient also (E_1, ν_{12}) and not so appropriate values for the other two parameters (E_2, G_{12}). By using the Halpin – Tsai equations, very good values may be obtained for all 4 material parameters. In order to use the Halpin – Tsai equations, their proportions into the material and a reinforcing coefficient for which there are recommendations in the textbooks are assumed, knowing the mechanical features of the matrix and fibres.

In order to calculate the resistance of a lamina the yielding criteria can be used. These criteria are also used when the laminate resistance is calculated. In this paper, we describe the most important yielding criteria: maximum stress yielding criterion, maximum deformation yielding criterion, Tsai – Hill criterion, Hoffman criterion, Tsai – Wu criterion.

A laminate (plate) is made from several lamina stuck together. The resistance and stiffness characteristics of the laminate depend on the lamina resistance and stiffness characteristics and also on the manner of lamina stratification.

The constitutive law of a laminate is written between the generalized forces and displacements. The generalized forces are the resultant forces and moments on the laminate thickness while the generalized displacements are the specific deformations and the curves corresponding to the laminate centre. These relations are described along with the calculation programs for the calculation of both the stiffness and the flexibility matrices of a laminate.

The stresses of a laminate are connected, meaning that a tensile stress can produce the curving and/or torsion of the laminate and, in practice, it is preferred the use of the uncoupled laminates or even of the quasi-isotropic ones.

In order to define the stiffness of a laminate, in practice, it is often used the effective stiffness. This means that the laminate is approximated with an orthotropic plate. Giving the fact that in practice, the use of uncoupled or even quasi-isotropic composite materials are preferred, this manner of defining the material is very appropriate.

The laminate stiffness and resistance can be determined by measuring methods or they can be calculated. It is observed that the measurements generally have a good dispersion and, therefore, it is necessary to be repeated many times. The calculation algorithm and a complex program designed for the calculation of the laminate resistance will be presented. In order to make the calculation, on the laminate, a system of forces is applied and its intensity is gradually increased aiming at the gradual yielding of the material.

The resistance and stiffness of a laminate are determined by the difference between the temperature the laminate was made at (the polymerization

temperature) and the temperature the laminate is used at. If there is such a temperature difference it means that the composite material is already pre-stressed even before it absorbs the stresses of the structure that it is part of. In this paper, the calculation relations which are used for establishing the effects of the temperature difference are presented.

For the numerical calculation of the structures made of composite materials were developed several methodologies. The simulations were ranked in an ascending order depending on the calculation effort. For the practical calculation of a structure it is chosen the suitable simulation considering the type of the material, the level of stresses and the calculation effort.

For the proper calculation of the structures, there are used numerical methods and the most common one is the finite element method based on the classic theory of the Kirchhoff laminate plates.

The presentation starts with the formulation of the equilibrium equations and of the boundary conditions and it ends with the formulation of the linear equations of the finite element method, equations which have as unknowns the displacements and rotations of the structure's nodes.

For the calculation of a laminate resistance it can also be used the finite element method. This type of calculation is presented and the results obtained with the finite element method are compared to the results obtained by using the special program designed especially for this purpose which is presented as an appendix of this essay.

The resistance structure of a boat can be calculated in various manners:

- the principles of a classification register may be used for a complete design;
- the principles of a classification register may be used for the calculation of the stresses (forces, pressures) and then, the structure can be calculated using the finite element method; in this case it starts with an initial project which is gradually adjusted till it reaches a solution considered to be optimal;
- a complete design may be done irrespective of the principles and afterwards it can be demonstrated to a classification register, with the appropriate documentation, that the structure is well calculated.

2. VALIDATION BY USING EXPERIMENTAL RESULTS OR RESULTS CALCULATED BY DIFFERENT AUTHORS

We are going to compare the results obtained with MATLAB program for the laminate resistance with the results obtained by different authors, with results obtained by direct measurement over the laminate and the results obtained by applying the finite element method. It will be observed that as an essential conclusion there is a good conformity between all these results.

In order to appreciate the capacity of the program to calculate values close to reality for the laminate resistance, systematic calculi have been done on a special type of laminate which is cross-ply.

A special type of laminate cross-ply formed of an unpaired number N of unidirectional layers is going to be taken into consideration. The layers have an orientation of 0 degrees and 90 degrees. The layers with an uneven number are oriented on x direction and the layers with an even number are oriented on y direction.

In addition, it is considered that the layers with the same orientation have the same thickness. Generally, inside the laminate there are two distinct thicknesses. M is going to be the proportion between the sum of uneven thicknesses and the sum of even thicknesses. The calculus is going to be done for and with a variation between 0.2 and 4.

A correlation was observed between stiffness and resistance calculated with MATLAB program and measured values obtained.

It can be observed that calculated stiffness is very close to the measured one. In conclusion, if the aim is to perform a linear-elastic calculus then this stiffness may be used without being necessary to perform direct measurements on the laminate.

At the same time, it was noticed that the values of the calculated resistance are a little higher than the measured ones, but the maximum difference is lower than 8%. Also, it was noticed that the measured values have a relatively high dispersion, generally higher than the error of calculated values comparing to the average of measured values.

In other words, if more precise values of the resistance are necessary as opposed to the calculated ones, then the measurement procedure has to be more rigorous and it must include many repeated measurements.

Taking into consideration that the values have a good quality and a minimum effort is implied to obtain them and that the measured values have a high dispersion and they imply a considerable effort in order to determine them, in practice choosing either one of them must be clear enough.

Also, in order to check the values of MATLAB program, it was calculated the resistance of an "angle-ply" laminate which has three layers of equal thickness oriented at a constant angle $\pm\alpha$. More precise, the orientations were: $[+\alpha, -\alpha, +\alpha]$. The angle had a variation in the interval of $[0^o, 90^o]$ and in each case the resistance was calculated. The mechanical properties of the layers were identical to the ones previously used.

The values calculated with MATLAB program were compared to the results found in the specialty literature. The values calculated with MATLAB program are practically identic to the ones calculated by Jones [3] and are very close to the values measured by Tsai [5].

The previously presented calculi are performed by using the methodology proposed by Tsai [5] and afterwards taken over by Jones [3]. If it is going to be used the newer (and more rational) methodology proposed for example by Sun [4] the following results are going to be obtained.

For the cross-ply laminate, the results are going to be the same no matter which is the value of the temperature:

$$\frac{N_x}{t} = (25000.0 \quad 30000.0 \quad 42857.0 \quad 75000.0 \quad 107144.0 \quad 120000.0), \text{ psi} \quad (1)$$

For the angle-ply laminate, the angles are:

$$\alpha = (15.0 \quad 30.0 \quad 45.0 \quad 60.0 \quad 75.0 \quad 90.0), \text{ degrees} \quad (2)$$

For the temperature of $\Delta T = 0^o$ the following resistances are obtained:

$$\frac{N_x}{t} = (37087.0 \quad 16875.0 \quad 8673.2 \quad 5332.7 \quad 4248.6 \quad 4000.0), \text{ psi} \quad (3)$$

and for the temperature of $\Delta T = -200^o$ the following resistances are obtained:

$$\frac{N_x}{t} = (34918.0 \quad 14561.0 \quad 6821.0 \quad 4313.4 \quad 3986.0 \quad 4000.0), \text{ psi} \quad (4)$$

3. THE VALIDATION MADE BY USING THE RESULTS OBTAINED FROM THE FINITE ELEMENT ANALYSIS

For an additional verification, the cross-ply laminate was analysed by using the finite element method. In this case, it was used the COSMOS/M program, which is a finite element program with general use, in order to calculate the laminate resistance. Giving the fact that the COSMOS/M is using the Tsai-Wu yielding criterion, the calculations presented above were based on this criterion.

In addition, in the MATLAB program the initial state, unstressed (unloaded) was used as reference at every step of the loading process. In order to use a finite element program, of general use, for the calculation of the laminate resistance, a part of the laminate is extracted, of finite dimensions and stresses and limiting conditions are applied on. This part will be further named: “structure”.

The forces are incrementally applied (small steps) and it is observed how the structure is gradually yielding. The stresses which occur depend on the manner the forces are applied, on the limiting conditions and on the structure shape. All these three factors can act as stress raisers. Thus, the occurrence of the forces, the shape of the field and the type of the limiting conditions are established in such a way that the stresses/deformations distribution matches the theoretical one, in order to compare the results.

The finite element programs of general use cannot determine exactly the forces under which, into the various layers, the matrix or the fibres are yielding. These are obtained for the limiting forces (inferior and superior) depending on the forces' increments size. The miscalculation of the yielding forces is at most a force increment. A resistance calculation does usually end with an error or a warning message which indicates the fact that the structure yielded.

For the calculation process, it is considered that la laminate (structure) has a square shape and the following dimensions: 1 in x 1 in. The calculation field (square) is discretized in four finite elements. In order to simulate the theoretical deformation state, the rotations within every knot were blocked. In addition, on the vertical border from x = 0, the translations on direction x were blocked. On the vertical border from x = 1 it was applied a stress (fictional) of 1 lb / in2. The stress of 1 lb / in2 was then multiplied with ascending factors in order to simulate the incremental stress.

100 loading steps of 30 lb / in2 were applied on the structure. This means that there were applied, in an ascending order 30 lb / in2, 60 lb / in2, 90 lb / in2, … . Of course, at one step of the loading, the program indicated an informative message regarding the fact that the structure yielded and then the calculation process was stopped.

Taking into consideration the shape of the calculus domain, the boundary conditions and the way the strains were applied, the stresses and the deformations from all four elements are identical.

It can be seen that on the layer from the middle of the laminate the value of the breaking criteria is very close to the limit value 1. So, the first breaking takes place between loading step 178 and 179 which means between pressures 178*30 lb/in2 and 179*30 lb/in2 meaning between pressures 5340 lb/in2 and 5370 lb/in2.

With this purpose, the value NX is going to be calculated as being 5340*0.06 = 320.4 lb/in. The values obtained for the pressure are in accordance with the values calculated by using MATLAB program. By using MATLAB program the value obtained for the pressure at the first break is 5363.0 lb/in2. Also, the stresses obtained on the first and second layer before the first break are:

$$\sigma_{xy}^{(1)} = \begin{pmatrix} 12187.0 \\ 639.73 \\ -4.5878 \cdot 10^{-15} \end{pmatrix}, \quad \sigma_{xy}^{(2)} = \begin{pmatrix} 3998.3 \\ -127.95 \\ -2.5358 \cdot 10^{-13} \end{pmatrix}. \quad (5)$$

And after the break:

$$\sigma_{xy}^{(1)} = \begin{pmatrix} 32178.0 \\ 2513.9 \\ 1.5393 \cdot 10^{-13} \end{pmatrix}, \quad \sigma_{xy}^{(2)} = \begin{pmatrix} 0.010517 \\ -502.78 \\ -7.8299 \cdot 10^{-19} \end{pmatrix}. \quad (6)$$

Further on, the list of results of COSMOS/M program is showing a new break at step 323. At this particular step, the matrix of layer 1 and 3 is breaking and it can be noticed that the breaking criteria has a very close value to the critical value 1. The pressure correspondent to the break is between 323*30 and 324*30 lb/in2 meaning between 9690 and 9720 lb/in2.

From the MATLAB program the following stresses are being obtained on the layers before the break:

$$\sigma_{xy}^{(1)} = \begin{pmatrix} 58153.0 \\ 4543.2 \\ 2.7819 \cdot 10^{-13} \end{pmatrix}, \quad \sigma_{xy}^{(2)} = \begin{pmatrix} 0.019006 \\ -908.64 \\ -1.415 \cdot 10^{-18} \end{pmatrix}. \quad (7)$$

and the breaking value 9692.1 lb/in2. After the break, the values of the stresses are:

$$\sigma_{xy}^{(1)} = \begin{pmatrix} 58153.0 \\ 4.8461 \cdot 10^{-9} \\ 3.8043 \cdot 10^{-20} \end{pmatrix}, \sigma_{xy}^{(2)} = \begin{pmatrix} 0.019384 \\ -9.6921 \cdot 10^{-10} \\ -1.1793 \cdot 10^{-18} \end{pmatrix}. \quad (8)$$

By looking at the results' list from COSMOS/M the following message can be noticed at step 816: Stop: The material is considered to be "failed" due to large strain (> 100%) for element 1 layer 1 time step 816. So, the breaking pressure according to COSMOS/M is between 815*30 and 816*30 lb/in2 meaning 24450 and 24480 lb/in2. With the MATLAB program the value of the breaking pressure is 25000.0 lb/in2.

Adequately, the stresses from layer 1 are:

$$\sigma_{xy}^{(1)} = \begin{pmatrix} 150000.0 \\ 1.25 \cdot 10^{-8} \\ 9.8129 \cdot 10^{-20} \end{pmatrix}. \quad (9)$$

In conclusion, it can be noticed a very good conformity between results of MATLAB program and the results obtained by using the finite element method and COSMOS/M program.

4. CONCLUSIONS

In this paper we used results published in the specialty literature in order to confirm the quality of the program for the calculus of laminate resistance. It was noticed a very good conformity between the results of MATLAB program, the measurements' results and the calculated results of different authors. In order to perform a supplementary verification we also used the finite element method and the same results were obtained.

If anyone compares the effort applied by a user in order to calculate the resistances of a laminate by using the proposed MATLAB program with the necessary effort for using the finite element method it can be noticed that the proposed program is obviously advantageous.

Besides the effort for the finite element method there is also the problem of costs: zero cost for MATLAB program and a very important cost in the case of acquiring a program based on using the finite element method. The second cost is so high that there is no way that such a program would be acquired only for the calculus of laminate resistance.

From the specialty literature we could notice that such programs for calculus of laminate resistance were accomplished but they are only for internal use (not for sale).

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STRUCTURAL CHANGES IN SUPERFICIAL LAYER OBTAINED THROUGH OVERLAYING WELDING

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ABSTRACT

The paper shows getting tougher superficial metal layers by microalloying and deposition. To achieve such layers it used overlaying welding on samples of OT 450 cast steel. This steel was chosen as support material because in many situations from such material pour directly finished pieces which can then undergo superficial thermal processing to improve their physical and mechanical properties of metallic material in the outer layers. The electrodes used are from cast iron alloyed with 30% chromium. These electrodes were used because, in literature, the white cast irons high alloyed chrome are appreciated that the materials used to overlaying welding of pieces that working in conditions of accelerated wear. Thus such layers must be characterized by very high hardness values.

Keywords: *overlaying welding, superficial metal layers, hard surfaces*, *white cast iron, structural analysis.*

1. INTRODUCTION

Superficial hardening of parts not due neither phase transformations nor the formation of chemical compounds. Hardening occur when material from the surface of a metal piece is alloyed with elements that lead to the formation of new phases (eg solid solutions) with mechanical properties much better than the basic structure. A similar situation occurs when the surface of metal pieces made of a weak material is applied through proper technique a layer of additional metal material with superior physical and mechanical properties of the substrate.

Overall performances (eg sustainability, efficiency) of layers obtained from overlaying welding depends largely on the nature of structural constituents obtained from loading and compatibility of basic material and the deposition.

2. METHODOLOGY AND MATERIALS

The experiments aimed obtaining hard surfaces after overlaying welding using welding electrodes from a white cast iron alloyed with 30 % chromium, on samples of cast steel OT 450.

The hard layer deposition was done by manual electric welding in constant regime on the surface of a steel samples OT 450, at the following parameters work:

- welding current, I_S – 225A
- arc voltage U_a – 25 V
- welding speed V_S – $6x10^{-3}$ m/s
- preheating temperature T_i – 200°C
- type of current – continuous current
- polarity - direct

The electrodes used in the experiments were electrodes obtained through casting, the form of metal rods, from a white cast iron alloyed with chromium. Chemical composition of electrodes used is given in table 1.

Chemical composition of the cast iron electrode is in the usual limits set for high alloyed cast iron with chromium, except for the addition of cobalt which was deliberately introduced in the composition in order to increase hardness deposited layer.

Table 1. Material deposited by welding

Chemical composition	[%]
C	3
Mn	1,2
Cr	30
Mo	0,1
Si	2
Ni	1,5 – 2
Co	1,5

The proportion of silica was kept at 2% for to improve the alloy castability.

In structure of the surface metal layer formed by deposition welding, chromium acts as stabilizer by carbides as and an element that narrows the γ phase field. Because of this, at high chromium content, in structure is formed a series of carbides rich in chromium, but in the same time, diminishes the stability field of austenite.

The percentage of carbon is very important because as the approaching of the eutectic carbon value, for chromium content given the carbides is finished. This leads to finishing the structure and consequently, at the improve the mechanical properties of the deposited layer.

The presence of carbon in cast irons alloyed with chromium favors the formation of carbides in layer. In Fe-C-Cr diagram for a given carbon content, the alloy structure contain different carbides or combinations of carbides depending on the degree of alloying with chromium. The hardness of such carbides can reach values of up to 1100 HV.

For to use the cast iron rods as electrodes work was done an electrode paste from graphite 30%, ferro-chrome 4%, calcium carbonate ($CaCO_3$) 25%, calcium fluoride (CaF_2) 25%, barium carbonate ($BaCO_3$) 6% and plasticizers (alumina and talc powder) 10%. Such an

electrode paste is used at the electrodes achievement intended for welding of cast iron because provide good protection of the arc and a minimum slag formation.

Ferroalloys and plasticizers act as oxidants and alloying components, through melting down combines with the deposited material. The application of the electrode paste on the electrodes was made using a binder on the basis of sodium silicate.

The structure investigations will be made with X-rays diffraction techniques.

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The structure investigations will be made with X-rays diffraction techniques.

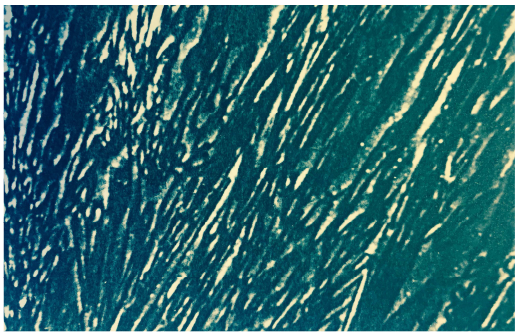
3. RESULTS AND DISCUSSIONS

After depositing through manual electric welding it was determined the chemical composition of the newly formed material layer.

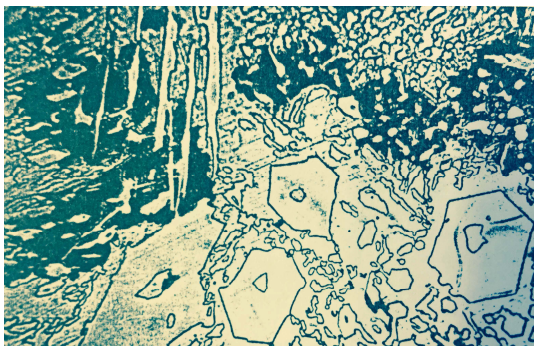
Table 2. The chemical composition of the material from superficial layer

Chemical composition	[%]
C	2,96
Si	1,86
Mn	1,10
P	0,025
S	0,014
Ni	1,52
Cr	29,4
W	0,26
Mo	0,12
Co	1,2

Structural changes occurring in the newly formed layer were revealed by optic metallographic microscopy.



a. Microstructure near the surface layer



b. Microstructure in layer

Figure 1 Microstructures in the deposited layer through welding with cast iron alloyed with Cr electrode

In the outer area of the deposition, near the surface of layer, was revealed a white cast iron structure with a high content of ally cementite, fine chromium carbides and few small areas perlite (Figure 1.a).

To the interior of the layer, the structure is finished strong, cementite appears in the form of thin needles, increase the amount of perlite (the black areas) and chromium carbide enlarge and have typical aspect of constituents who crystallizes in hexagonal system (Figure 1, b).

The material area near the substrate is an area with dendritic structure, the passing from deposited layer at sample material being made by a darker strip rich perlite (Figure 2).

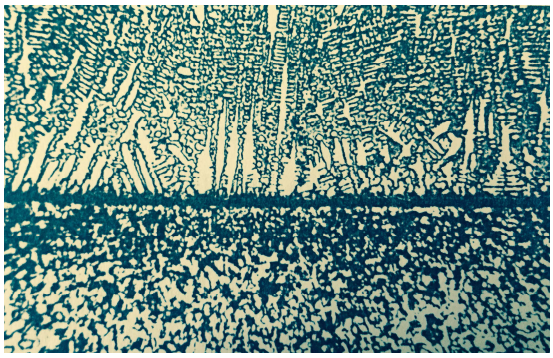


Figure 2 Microstructure in the transition area from the layer deposited structure at the basic structure of the sample

In the base material, at the contact with the deposited layer, it observe an area of material with an amount of perlite higher than the base sample structure and fine carbide which are formed by diffusion of carbon, chromium and manganese from the superficial layer deposited. Such an area can be seen in the portion of the material what belong the substrate.

In the bottom of the microstructure apear the basic structure of the sample which is consist from ferrite and pearlite

The cobalt present in the superficial layer can not be emphasized by optical microscopy because the cobalt dissolves in ferrite and form a solid solution leading to an increase in the hardness of this phase and therefore contribute to increase the superficial layer hardness.

The investigations for superficial layers was made with DRON 3 difractometer which has a radiation tube with molybdenum anode, under the following working conditions: radiation MoK_{α}, with λ_{Mo} = 0.7107 $\dot{A}$; the acceleration tension on the tube: 40 KV; cathode current supply: 15 mA; sample rotation speed: $\omega_1 = 4^o / \min$ inscription band speed: 1800 mm/h; working slit: 1 mm and 0.5 mm.

By using Bragg equation it was determined that the structure interplanar spacing, which was generated by the diffraction maximums and the crystalline phases which compose the superficial layers were identified.

$$2d_{hkl} \cdot \sin\theta_i = n \cdot \lambda , \qquad (1)$$

where:

d_{hkl}- distance between two planes with (hkl) indexes:

θ_i - diffraction angle

n - diffraction order

λ- waves length for X – radiation.

Diffraction peaks present in the diffraction X-ray pattern give phase composition of the surface layer analyzed.

Diffraction dates are presented in table 3.

Table 3. Diffraction data obtained by depositing with cast iron alloyed with Cr electrode

No	$2\Theta_i$ [deg]	d_{hkl} computed [Å]	d_{hkl} standard [Å]	hkl	Phase
1	16.00	2.55	2.53	201	Cr_3C_2
2	17.17	2.38	2.38	112	Fe_3C
3	18.53	2.20	2.21	120	Fe_3C
4	20.40	2.00	2.00	022	Fe_3C
5	22.33	1.84	1.84	402	Cr_7C_3
6	22.86	1.79	1.79	531	$Cr_{23}C_6$
7	25.93	1.58	1.58	130	Fe_3C
8	26.76	1.53	1.54	620	Cr_3C_2
9	27.13	1.51	1.50	222	Fe_3C
10	28.73	1.43	1.43	024	Fe_3C
11	29.13	1.41	1.42	200	Feα
12	32.13	1.28	1.28	644	$Cr_{23}C_6$
13	33.88	1.21	1.21	322	Fe_3C
14	34.20	1.20	1.20	141	Fe_3C

Analysis of data presented, shows that the phase which generates the most intense maximum and that holds a significant share in the structure is cementite (Fe_3C), is targeted the maximum from angular position $2\Theta = 20.40^o$ for a interplanar spacing d_{110} = 2.00 Å.

Alongside cementite in this structure, apear ferrite from pearlite because diffractometer does not recognize the pearlite like a phase with own structure

An important number of diffraction maximum have been identified as belonging to the chromium carbides, Cr_3C_2, Cr_7C_3, and $Cr_{23}C_6$ which were observed by optical microscopy on the microstructures of Figures 1 and 2.

For a more complete analysis of the layer structure were performed the analyses with the EDAX electronic microprobe.

These investigations were made both on the basic material and layer samples obtained after overlaying welding.

The electronic microprobe determinations shows compositional difference between the basic structure of the sample and the result layer after overlaying welding using welding electrodes from a white cast iron alloyed with 30 % chromium.

Spectral line the most important for the base material is for α phase but notice some lines very weak in intensity. These belong to Si, Cr, Mn and Ni which are elements accompanying in the structure.

In the material layer deposited is highlighted a strong maximum for α ferrite and one of very high intensity, belonging chromium.

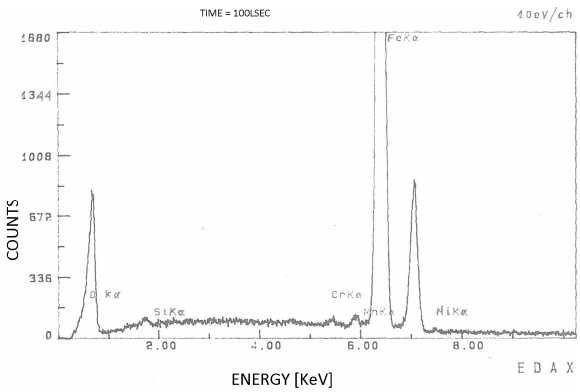


Figure 4 EDAX spectrum recorded on the basic structure of steel sample OT 450

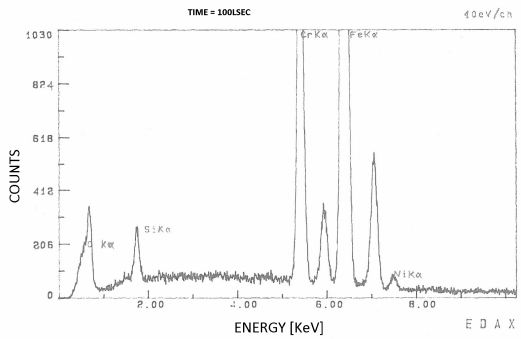


Figure 5 EDAX spectrum recorded on the layer obtained after overlaying welding using welding electrodes from a white cast iron

Analysis with electron microprobe certify massive presence of chromium in the layer deposited, which guarantees the formation of hard carbides in the superficial layer structure.

Along with the spectral lines of iron and chromium in the superficial layer stands a few well-defined lines, but not very strong what belong silicon and nickel.

4. CONCLUSIONS

The superficial metal layers resulting from microalloying and deposition, involves a contribution of a material from exterior which in combination with the base material give tough phases type solid solutions. Over these appear the deposition from activ material electrode.

Overlaying welding allows obtaining consistent layers (by milimeter order) of material very tough.

The iron cast alloyed with chromium electrode used at overlaying welding leads to the formation of chromium large carbides, by hexagon shape , very hard, in a field of ally cementite.

The layer structure is outwards coarser and finer inside.

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THE IMPLEMENTATION OF THE INTEGRATED PROGRAMME FOR MANAGEMENT OF AIR QUALITY IN URBAN AREAS OF CONSTANTA COUNTY

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ABSTRACT

Air quality monitoring is a current issue of concern in terms of a more powerful anthropogenic pressure on large urban agglomerations. Ever more marked pollution of cities increases the number of diseases in the population, the development of allergic reactions and poisoning and other pathological phenomenons. On a national level it has adopted a Program of Integrated Management of the Air Quality, program that was implemented at county level. This involved of the one part monitoring air parameters by means of some stations located in representative areas, on the other side- measures to limit the values recorded for certain parameters. The measures were taken both in the main local authorities and economic agents involved.

Keywords: *air quality, pollutants, stations, urban traffic.*

1. INTRODUCTION

Urban environments are a reality of the contemporary world. Through their daily activities, people exert increasing pressure on the environment and on air quality default.

Besides the increase in number of urban population, powerless we are witnessing to the increasing number of motor vehicles in cities. Intersections are becoming more crowded; waiting times at traffic lights are growing.

In Constanta County most of the population lives in urban areas (more than 70%).

The average density in the county of Constanta is 102 people / km², with higher concentrations in coastal area and along the Danube-Black Sea Canal.

According to the data from the last Census, in Constanta City the population density is 2273 people/ km² and in Mangalia City the population density is 661 people/ km².

2. DATA MONITORING

For overseeing air quality in urban environments in Constanta County, data obtained through monitoring network is used, consisting of seven automatic stations. Automated network monitoring is a component of the National Network of Monitoring.

The seven automatic stations were located in representative areas: two are traffic stations, three are industrial stations, one is urban background station and one is suburban.

The pollutants monitored are those set out in European Directives on Air Quality in the Environment: SO_2, NO_2, NO_x, CO, Pb, PM_{10} or $PM_{2,5}$, benzene, ozone O_3.

Data from measurements are made public via the information panel located near the station CT1 and by two totems, located in Constanta City Hall and in the Environmental Protection Agency.

Measuring pollutants in fixed points is performed using reference methods such as:

- Sulphur dioxide: ultraviolet fluorescence method, according ISO/FDIS 10498
- Nitrogen dioxide: by chemo-luminescence method, according ISO 7996/1985
- Plumb: atomic absorption spectroscopy method
- PM_{10} : measuring principle is based on the fraction PM_{10} collection filters particulate matter and determine their mass using gravimetric method, according EN12341
- Benzene: gas chromatography method
- Carbon monoxide - Non-dispersive infrared spectrometric method (NDIR), according ISO 4224
- Ozone - UV photometric method, according ISO 13964

2.1. Station House of Culture (CT 1)

- *Zone type*: urban
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, PM_{10}, C_6H_6
- *Characterizing the area*: residential and commercial, located 500 m far from two major intersections
- *The number of local inhabitants*: over 20,000
- *Traffic*: intense, over 10,000 vehicles / day
- Height of sampling point: 4-5 m
- Length of sampling line: 1.8 m

The main emission sources placed near the station: production processes, using of solvents, traffic, natural factors, others mobile sources.

Figure 1 Station CT 1

2.2 Station Fantasio (CT 2)- City Hall zone

- *Zone type*: urban background
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, $PM_{2,5}$, C_6H_6, O_3, toluene, ethyl-benzene, o, m, p- xylene
- *Characterizing the area*: residential and recreation, with influences from the port area
- *The number of local inhabitants*: over 95,000
- *Traffic*: intense, over 10,000 vehicles / day, large streets
- *Area of representativeness*: 1-5 km

The main emission sources are placed near the station: production processes, using of solvents, traffic, natural factors, others mobile sources.

The monitoring point has included a meteorological station that performs measurements of:

- Temperature
- Wind speed and direction
- Relative humidity
- Atmospheric pressure
- Solar radiation
- Precipitations

Figure 2 Station CT 2

2.3 Station Navodari Camp (CT 3)

- *Zone type*: suburban background
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, $PM_{2,5}$, C_6H_6, O_3, toluene, ethyl-benzene, o, m, p- xylene
- *Characterizing the area*: recreation, with influences from Navodari industrial area and from traffic
- *The number of local inhabitants*: variable, depending on the season
- *Traffic*: intense, over 10,000 vehicles / day, large streets
- *Area of representativeness*: 25-150 km

The main emission sources are placed near the station: burning in the processing industry and for the production of electricity and heat, non-industrial combustion installations, combustion in manufacturing industry, production processes, using of solvents, traffic, natural factors, others mobile sources.

The monitoring point has included a meteorological station that performs measurements of:

- Temperature
- Wind speed and direction
- Relative humidity
- Atmospheric pressure
- Solar radiation

* For a while, because the works for widening the road, this station cannot be connected to the electrical installation and was not functional.

Figure 3 Station CT 3

2.4 Station Mangalia (CT 4)

on the main road passing the city centre

- *Station type*: traffic
- *Zone type*: urban
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, PM_{10}, C_6H_6
- *Characterizing the area*: residential and commercial
- *Traffic*: moderate, 2 000- 10,000 vehicles / day, large streets
- Height of sampling point: 4-5 m
- Length of sampling line: 1.8 m

The main emission sources are placed near the station: burning in the processing industry and for the production of electricity and heat, non-industrial combustion installations, production processes, using of solvents, traffic, natural factors, others mobile sources.

The monitoring point has included a meteorological station that performs measurements of:

- Temperature
- Wind speed and direction
- Relative humidity
- Atmospheric pressure
- Solar radiation
- Precipitations

Figure 4 Station CT 4

2.5. Station "Prelungirea Liliacului" (CT 5)

- *Station type*: industrial
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, PM_{10}, C_6H_6
- *Characterizing the area*: residential, with influences from industrial area and from traffic
- *The number of local inhabitants*: 50 000
- *Traffic*: moderate, 2 000- 10,000 vehicles / day, narrow streets
- *Area of representativeness*: 1 km
- Height of sampling point: 4-5 m
- Length of sampling line: 1.8 m

The main emission sources are placed near the station: burning in the processing industry and for the production of electricity and heat, non-industrial combustion installations, waste treatment and disposal, production processes, using of solvents, traffic, natural factors, others mobile sources.

The monitoring point has included a meteorological station that performs measurements of:

- Temperature
- Wind speed and direction
- Relative humidity
- Atmospheric pressure
- Solar radiation

Figure 5 Station CT 5

2.6. Station Chemistry High School (CT 6)

- *Station type*: industrial
- *Zone type*: urban
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, $PM_{2,5}$, C_6H_6, O_3, toluene, ethyl-benzene, o, m, p- xylene
- *Characterizing the area*: residential, the area may be affected by sources of industrial platform Navodari
- *The number of local inhabitants*: 27 000
- *Traffic*: low, under 2 000 vehicles / day, narrow streets
- Height of sampling point: 4-5 m
- Length of sampling line: 1.8 m

The main emission sources are placed near the station: burning in the processing industry and for the production of electricity and heat, non-industrial combustion installations, production processes, using of solvents, traffic, natural factors, others mobile sources.

Figure 6 Station CT 6

2.7 Station Medgidia (CT 7)

in central area, in front of the courtyard of City Hall, near to the divide between the industrial and residential areas.

- *Station type*: industrial
- *Zone type*: urban
- *Measured pollutants*: SO_2, NO_2, NO_x, CO, Pb, PM_{10}, C_6H_6, O_3
- *Characterizing the area*: residential,
- *Traffic*: low, under 2 000 vehicles / day, narrow streets.

The main emission sources are placed near the station: burning in the processing industry and for the production of electricity and heat, non-industrial combustion installations, production processes, traffic, natural factors, others mobile sources.

Figure 7 Station CT 7

3. ANALYSIS OF DATA

All data are collected and interpreted by specialized laboratories of the Environmental Protection Agency Constanta.

The results, since this procedure was implemented, have revealed some exceeding the limit values and / or target values for some monitored parameters.

Overtaking is done on information that is passed necessarily in the Dispatcher Ministry of Environment, National Environmental Protection Agency, National Guard Constanta County Commissioner environmental compartments and Constanta County Prefecture.

Long-term analysis obtained information of long data strings from seven monitoring stations in Constanta County have revealed exceeding the limit values for

particulate in suspension (PM_{10} or $PM_{2,5}$) and nitrogen oxides- NO_x.

Values for nitrogen dioxide are higher, especially in CT1 station in winter and lower in summer months, especially during June-September (during school summer holidays). In summer, the nearby station CT1 reveals a significant reduction in traffic.

Exceeding of daily limit values of particulate in suspension were recorded especially in periods from January to March and November-December.

The main pollution sources that generate exceeding the limit values are associated with: traffic, residential heating and industrial sources.

Particulate in suspension (PM_{10} or $PM_{2,5}$): are liquid or solid particles with a less than 10 microns diameter.

Natural sources include erosion of rocks, pollen dispersal and volcanic eruptions.

Anthropogenic sources are the industrial activity, population heating system, thermal power stations. Traffic contributes by tires powders produced at the stopping cars and due to incomplete combustion.

Health effects: dust toxicity is due not only physic-chemical characteristics but also their size. Those with a diameter of 5 to 10 microns -PM_{10} and from 2.5 to 5 microns - $PM_{2,5}$ are at high risk of going into the alveoli causing inflammation and intoxications. Vehicles emit other gases and irritating, toxic elements (Cd, Pb, As, etc.) and carcinogens (polycyclic aromatic hydrocarbons, aldehydes, nitro-compounds).

Nitrogen oxides (NO_x): at the ambient temperature are present in gaseous form. Anthropogenic origin has the source in residential heating and discharges exhaust gases from motor vehicles when accelerating or at high speeds.

Health effects: mucosal irritant gas that affects the respiratory system and diminishes breathing capacity. Nitrogen oxides cause acid rain and favour the accumulation of nitrates in the soil, which can cause alteration of ecological balance of the environment.

4. ACTIONS FOR REDUCING POLLUTION

To reduce the limit values recorded at NO_x and $PM_{2,5/10,}$ a series of measures were taken. Many of them were carried out successfully.

Major economic agents that pollute, proposed and implemented modernization of facilities, changing filters and optimization of industrial process control to reduce emissions.

At the level of local governments, taken a number of measures related to traffic was taken:

- creating new one-way streets in traffic;
- creating pedestrian areas in peninsular area of the city (Old Town);
- prohibiting parking cars on the first lane;
- traffic lights at intersections and roundabouts creation depending on the circulation's evolution;
- creating routes for heavy traffic- the beltway
- restricting traffic vehicles with total authorized weight over 7.5 tonnes in the centre of Medgidia city
- rehabilitation and modernization of county roads - DJ section 228: DN22C (Nazarcea) - DN 2A (Ovidiu);
- new vehicles with low emissions, encouraged by the "Rabla" project in Constanta County.

Other measures aimed at developing and arrangement of green areas:

- planting flowers, shrubs, lawns recovery in the House of Culture;
- rehabilitation of green areas in zones: Tabacarie- Expoflora, Carol I Park;
- modernization of green areas in Medgidia;
- creating new green areas in Mangalia City
- afforestation of degraded lands of Development Association Medgidia territory.

Another issue is the promotion of alternative energy sources (solar, heat pumps etc.).

For various reasons, some measures initially proposed could not be implemented at all or have been performed only in a certain proportion.

There were times when the projects were not approved for funding and situations where reduced by budget spending and was dropped at some stages of implementation measures. Most of the proposed roundabouts were built, even if the existing space was enough to give a radius of curvature of a favourable effective streamlining traffic.

5. CONCLUSIONS

Currently, the air quality in urban environments situation in Constanta County, according to the Environmental Protection Agency monthly and annual reports, shows to be generally good.

Even if producing still causes some exceeding the limit values, in particular parameter particulate matter, they are somewhat natural in the context of busy traffic and seasonal variations in terms of heating sources of population and variations in the number of population related to tourist flows.

In April 2015 a Government decision approving the Methodology for drafting air quality plans, action plans and short-term plans to maintain air quality, became effective. And because the air in urban areas of the county of Constanta is at least good, Constanta County Council must carry out a plan for only maintaining its quality.

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THE MATHEMATIC SIMULATION REGARDING THE RESISTANCE STRUCTURE OF A VESSEL

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ABSTRACT

Designing a vessel is a complex process in which the choice of the construction materials represents one of the most important steps. In time, vessels have been built by using various materials. It began with papyrus in Egypt, bulrush in North America, bamboo in China, then for a long period of time the vessels were built of wood and now, in the modern times, the vessels are built of steel, concrete (iron cement), aluminium and composite materials. The material is chosen depending on various factors. The available technology is probably the most important one. Supposing that technology can be chosen without any restriction, the other factors which influence the choice are: the designation of the vessel, its dimensions and weight, prime cost, upkeep cost, navigability, the impact strength and corrosion resistance, etc.

Given the fact that presently leisure vessels are built almost exclusively of composite materials, the present paper is dedicated to the study of the properties of these materials and their usage. Because the vessels are made mainly out of fibre reinforced composite materials, the stress will be laid on these materials' behaviour.

Keywords: *vessel, construction material, structure, finite element.*

1. INTRODUCTION

In practice, the most common structural elements are the plates. Therefore, we will present the calculation of the structures made of composite materials, such as laminate plates.

In the calculation of the composite materials structures three approaches may be used:

A. The stratification of the composites plates can be ignored; in this case it is considered that these plates are either isotropic or orthotropic and they can be calculated as standard metallic structures; of course, the stresses should not affect the area of the material yielding limits.
B. The stratification of the composite plates is considered but the fibre orientation into the matrix is ignored; this approach implies a greater calculation effort and more accurate information regarding the manner the material was created.
C. It runs at micro mechanical level and it respects the exact orientation of the fibres into the matrix; the accuracy is very high, the calculation effort is even higher and the method is practically inapplicable to the complex structures.

2. CHARACTERISTICS OF CALCULATED VESSEL

The resistance structure of the vessel was verified, by direct calculation, accordingly to the DNV laws, more precisely to the "DNV Rules for Classification of High Speed, Light Craft and Naval Surface Craft Structures, Equipment", effective since January 2011.

By calculation, an engine boat designed for trips on inland waters and on the open sea till a distance of 200 miles from the shore was verified, on a maximum 5 degrees sea.

The boat was designed according to the Germanisher Lloyd – Rules for Classification and Construction law, 2003.

The main dimensions are:

- body length 12.6 m
- maximum width 3.5 m
- depth 2.0 m
- draft 0.75 m
- frame spacing 0.4, 0.5, 0.55, 0.6 m

The projected draft of the vessel has the following characteristics:

- length on the waterline 10.88 m
- construction waterline 2.75 m
- displacement 11.70 t
- CB 0.523

Power and speed:

- maximum power at 3800 rpm 2x182kW (2x248 HP)
- maximum speed 25 Knots

Capacities:

- maximum number of persons onboard 12
- fuel 1100 l
- drinking water 250 l
- sanitary waste 107 l
- limber 67 l

Materials - glass fibre reinforced polyester, with the following characteristics:

- Stretching resistance 95 MPa
- Bending resistance 130 MPa
- Coefficient of elasticity 70000 MPa

Structural dimensions:

- keel (h x b x g) 120x110x13 mm

- bottom thickness 13 mm in the 0.4 L area from the transom 14 mm elsewhere
- skin thickness 10 mm
- deck thickness 8 mm
- superstructure thickness 6 mm
- transom thickness 55 mm

3. THE CALCULATION OF THE STRESSES AND DEFORMATIONS USING THE FINITE ELEMENT METHOD

For the calculation of the boat structure resistance it was used the COSMOSM 2010 program. This is a program of general use based on the finite element method and it is a part of the SolidWorks 2010 program series (package). The program has several versions, from the COSMOSM 64k to the COSMOSM 1024k version, divided by the maximum number of knots and elements which can be used for the structure discretization. For example, the COSMOSM 64k version can work with a maximum of 64000 knots and elements. COSMOSM is, in fact, a group of programs, of which the GEOSTAR program is used for the interface. This last program uses other various programs for the actual calculation or for the import / export of the files. The program allows the execution of some files of macro commands and, therefore, the program function can be extended. For example, this capability of the program can be used when the calculation of the boat is made, in order to apply on the structure, the hydrostatic forces.

In order to simulate a structure, first of all, a geometric model is designed, by using: dots, lines, surfaces, contour lines, areas, etc. Afterwards the types of the elements which will be used at the structure discretization are specified. In this particular case beam elements (BEAM3D) and plate elements (SHELL3T) are used.

Further, the structures are described, specifying the material mechanic properties and the areas characteristics. In the last part of the problem description, the limiting conditions (binding and bearing) and the forces (stresses) applied onto the structure are specified. After the problem description, the calculation options are introduced and thus the calculation is made and then the results are analysed.

In order to determine the structure shape of the vessel, the body plan and the construction plans of the boat are used. These plans were scanned and after that measurements were made on the obtained images. In order to measure the necessary rates and angles the freeware Plot Digitizer program was used, created by the Department of Physics of the University of South Alabama and the MB-Ruler program.

It is considered that according to the DNV rules the ship is subjected to the R3 class corresponding restrictions (coastal navigation).

According to the DNV rules maximum stresses and deformations for the plating elements subjected to compound stresses should obey the following restrictions:

$$\sigma \le 0.3\sigma_{nu}\text{, generally}$$

$$\sigma \le 0.2\sigma_{nu}, \quad (1)$$

in case of structures subjected longer to static loads

$$\delta = \frac{w}{t} \le 2$$

where:

- σ maximum equivalent stress in the structure;
- σ_{nu} rupture resistance during towing (95 MPa);
- w one plating deflection;
- t plating thickness;

For the calculus with the finite elements method and for generating the hydrostatic forces applied on the ship, the COSMOSM programme was used. In the COSMOSM programme, in order to generate hydrostatic forces, the external command is used (macro command) HSPR.

There is an important inconvenient for this command as it applies hydrostatic forces both below and over the sea level. Below the sea level, the hydrostatic forces calculated by HSPR have one direction, and over the sea level they have the reverse direction. Plus, HSPR applies hydrostatic forces to all plate type elements, which is an inconvenient as it imposes a thorough description of elements in such a way that the normal one at their surface would be persistent toward the exterior of the hull or towards the interior of the hull.

This is why it was necessary to write a macro command which applies correctly the hydrostatic force on the selected elements. Macro commands COSMOSM are sequences of instructions and commands COSMOSM, having a text format and grouped in the folder GEOMACRO.MAC.

3.1 Description of structure geometry

In order to perform the verifying calculus for the ship's resistance, the main components of the structure were described: bottom's surface, plating surface, deck surface, walls and framing elements' surface. It was considered that the above surfaces may be properly modelled by using finite plating elements and that the above lines may be properly modelled by using finite beam elements. Some structure elements were neglected as they were considered playing a negligible part in the ship's resistance.

In order to describe geometry, points were first introduced. Points were used to generate lines. Based on lines, surfaces have been built. Also based on lines, contours were built and based on those, regions were built. Finally, a mathematical description of the hull's surface and transverse bulkheads resulted from using surfaces and regions. Distinction between surfaces and regions is specific for COSMOSM programme. Both surfaces and regions are eventually still surfaces. In COSMOSM surfaces are easily built having a simple contour and more complicated regions. That is, choosing the surface or region is determined by the type of contour.

In Figure 1 curves, surfaces and regions are represented.

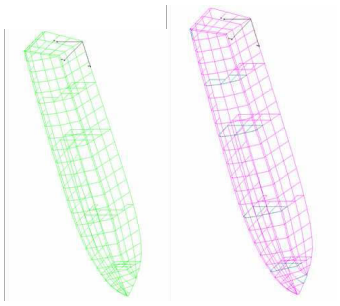

Figure 1 Curves, surfaces and regions

3.2 Boundary conditions

Two groups of boundary conditions were applied. The first group of boundary conditions was applied in order to calculate the general resistance corresponding to loading in calm water. The second group of boundary conditions was applied in order to calculate local resistance of the bottom and plating. In case of loading in calm water, the following boundary conditions were used:

- symmetry conditions in the diametric plane (blockages: translation z, rotation x, rotation y);
- suspension conditions in two points at fore and aft extremities (blockages right forward: translation y, z; blockages right aft: translation x, y, z).

In Figure 2 limit conditions were graphically represented for loading in calm water.

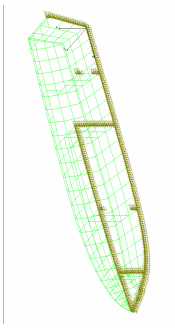

Figure 2 Boundary conditions in calm water

In case of calculating the local resistance of the bottom and plating, the following limit conditions were used:

- symmetry conditions in the diametric plan (blockages: translation z, rotation x, rotation y);
- simple suspension conditions in two points right forward and right aft (blockages right forward: translation y, z; blockages right aft: translation x, y, z);
- vertical suspension on the rail (blockages: translation y);
- horizontal suspension on the mirror (blockages: translation x);
- Vertical suspension at the deck level for transverse bulkheads (blockages: translation y).

In Figure 3 boundary conditions were represented in the local resistance calculus for the bottom and plating.

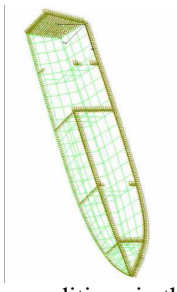

Figure 3 Boundary conditions in the calculus of local resistance of the bottom and plating

3.3 Loads

Two groups of loads were applied. In the general resistance calculus, corresponding to loading in calm water, the following have been considered:

- hydrostatic pressures; it was considered that hydrostatic forces are constant at the finite element level;
- the structure's own weight; it was considered that the weight of the ship is equal to displacement (converted of course in Newton) because at the time of the calculus there was not enough information available about the weights' distribution on board the ship; then based on this weight and volume of the structure's material, an equivalent density of the structure was calculated; finally, it was considered that weights are proportionally distributed with the structure's volume distribution, using for the weights calculus the following: gravity acceleration, volume and equivalent density; accuracy was very good and determined by the weight of the body having the highest proportion in the ship's weight.

In Figure 4 hydrostatic pressures were presented applied on the ship's body in the general resistance calculus.

In case of the local resistance calculus the following were considered:

- loads applied on the bottom calculated according to DNV rules;
- loads applied on the plating calculated according to DNV rules;

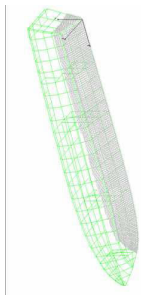

Figure 4 Hydrostatic pressures applied on the ship's hull in the general resistance calculus

In Figure 5 pressures were represented applied on the bottom in the local resistance calculus according to DNV.

In Figure 6 pressures applied on the bottom and plating were represented in the local resistance calculus according to DNV.

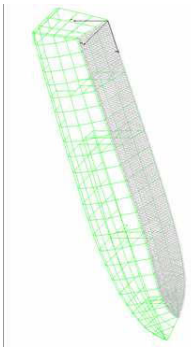

Figure 5 Pressures applied on the bottom in the local resistance calculus according to DNV

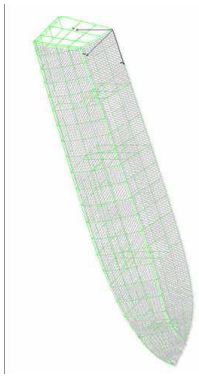

Figure 6 Pressures applied on the bottom and plating in the local resistance calculus according to DNV

3.4 General resistance calculus

In the particular case of this ship, register rules (DNV) do not impose a general resistance calculus. Therefore, there are no rules according to which this calculus could be performed. A general resistance calculus was made in order to appreciate the general level of stresses when the ship sails in normal calm water conditions. Another reason was modifying the modelled shapes of the ship with finite elements.

From the finite elements calculus we obtained the following result: displacement (as a result of the hydrostatic forces) and amidships position (coordinate x of the hull's centre calculated based on the reaction from the imposed suspensions right forward and right aft). Very low errors (negligible) resulted in the calculus of the displacement and in position on the length of the hull's centre confirmed the quality of the digitization in the finite elements.

In Figure 7 equivalent von Mises stresses were represented as result of the general resistance calculus (MPa).

In Figure 8 equivalent von Mises stresses were represented on the bottom and plating resulted from the calculus of the general resistance (MPa).

In Figure 9 displacement results were represented on the bottom and plating in the general resistance calculus (mm).

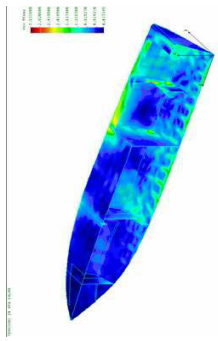

Figure 7 Equivalent von Mises stresses in the general resistance calculus (MPa)

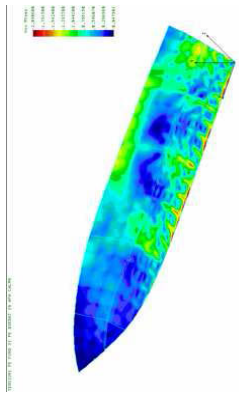

Figure 8 Equivalent von Mises stresses on the bottom and plating in the general resistance calculus (MPa)

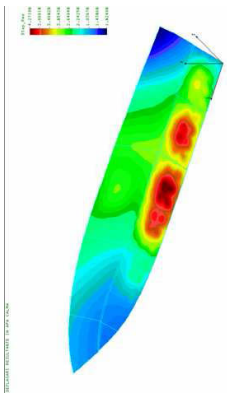

Figure 9 Resultant of the bottom and plating displacements in the calculus of general resistance (mm)

3.5 Local resistance calculus considering loads on the bottom

Pressures calculated according to DNV rules are used as loads. These pressures are calculated in extreme slamming and pitching slamming conditions. For example, the pitching slamming pressures are calculated assuming that the ship slides with maximum speed and having a pitching movement.

In Figure 10 equivalent von Mises stresses were represented on the bottom and on the plating from the local resistance calculus with pressures on the bottom (MPa).

In Figure 11 displacement results on the bottom and plating are represented in the local resistance calculus with loads on the bottom (mm).

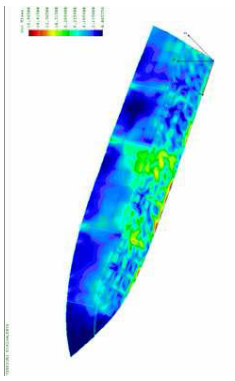

Figure 10 Equivalent von Mises stresses on the bottom and plating in the local resistance calculus with pressures on the bottom (MPa)

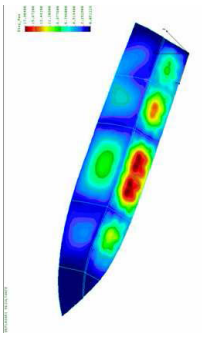

Figure 11 Displacements' resultant on the bottom and plating in the local resistance calculus with loads on the bottom (mm)

3.6 The local resistance calculus considering loads on the bottom and plating

Pressures calculated according to DNV rules are used as loads. These pressures are slamming and pitching slamming on the bottom and dynamic pressure of the sea on the plating.

In Figure 12 equivalent von Mises stresses were represented on the bottom and plating resulted from the local resistance with pressures on the bottom and plating (MPa).

In Figure 13 results of displacements on the bottom and plating were represented in the calculus of the local resistance with loads on the bottom and plating (mm).

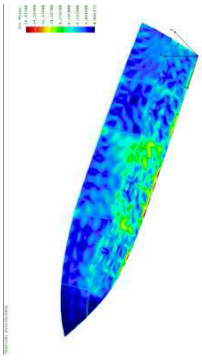

Figure 12 Equivalent von Mises stresses on the bottom and plating in the local resistance calculus with pressures on the bottom and plating (MPa)

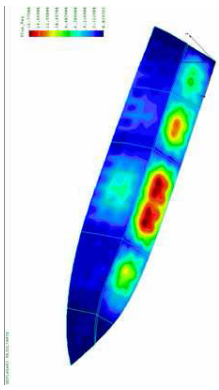

Figure 13 Resultant of the bottom's and plating's displacement in the local resistance calculus with loads on the bottom and plating (mm)

4. CONCLUSIONS

Further on, the main data/results used or resulted in/from the finite elements analysis are briefly presented.

1. Resistance structure of a light high speed boat was analysed, a boat which was designed according to the GL naval register rules.
2. Design loads (pressures) were calculated for the direct calculus of the resistance structure of the ship according to the DNV naval register rules: "DNV Rules for Classification of High Speed, Light Craft and Naval Surface Craft Structures, Equipment", rules still in use in January 2011.

According to these rules the following were calculated: vertical accelerations; pressure from slamming on the bottom; pressure from pitching slamming on the bottom; impact pressure at the bow on the forecastle and on the plating; dynamic pressure of the sea on the bottom and plating, pressures due to solid cargo, stores and equipment.

For the calculus, a calculating Excel sheet specially conceived for this paper in which the data introduced are general characteristics of the ship and the information extracted from the plan of forms was used and from which design loads result.

3. Stresses and admitting displacements were calculated according to the DNV naval register rules.

Considering that the resistance to rupture when towing is $95\,MPa$ it resulted that the admissible equivalent stress is $\sigma_{adm} = 28.5\,MPa$. From the rules it resulted that deformations are considered admissible if they respect the condition $w/t \le 2$, where w and t are transversal displacement of a plate and the plate's thickness.

4. The resistance structure was modelled for the ship with finite elements of the beam and plate in order to calculate resistance. For actually calculating the COSMOS/M programme was used, and structure was modelled with 2090 finite beam elements and 13666 finite plating elements.

The ship's framing was digitized by using beam elements (BEAM3D in COSMOSM), and plating (bottom, plating, deck, bulkheads) was digitized by using

plating elements (SHELL3T in COSMOSM). The numerical model totally contains 6968 nodes.

5. The Resistance calculus was performed for the ship's structure using the finite elements method. The COSMOS/M programme was used and several separate calculi were performed: general resistance calculus corresponding to loading in calm water; local resistance calculus corresponding to loading with slamming pressures on the bottom; local resistance calculus corresponding to loading with slamming pressures on the bottom and dynamic pressure of the sea on the plating.

General resistance calculus is not required by DNV rules because it is assumed that a ship which fulfils the requirements of local resistance implicitly fulfilling the general resistance requirements too. In this paper the general resistance calculus was performed especially with the purpose of establishing whether the structure was correctly modelled with finite elements. From the general resistance calculus, not only displacement and structure efforts resulted, but also displacement and position on the length of the hull's centre. These last two dimensions have been used as a global measure of the modelling quality of the structure's geometry. These two values have been practically identical with those in the project and confirmed accuracy of approximation with finite elements of the hull's surface.

From the general resistance, calculus maximum equivalent stresses resulted in the bottom's structure and the plating structure $\sigma_{ech} \leq 2.04\,MPa$ and also maximum displacements $w_{rez} \leq 4.27\,mm$. From the local resistance calculus corresponding to loading with slamming pressures on the bottom, maximum equivalent stresses resulted in the bottom's and plating's structure $\sigma_{ech} \leq 16.46\,MPa$ and also the maximum displacements $w_{rez} \leq 17.90\,mm$.

From the local resistance calculus corresponding to loading with pressures of slamming on the bottom and dynamic pressure of the sea on the plating, maximum equivalent stresses resulted in the bottom's and plating's structure $\sigma_{ech} \leq 16.43\,MPa$ and also maximum displacements $w_{rez} \leq 16.77\,mm$. A somehow paradox effect is noticed for the pressures on the plating: they lead to a reduction of stresses and displacements in the structure.

6. Diagrams with distribution of displacement and equivalent stresses were drawn on the structures' elements comparing the maximum values with DNV maximum admitted values.

For stresses it was noticed that $\sigma_{calc} = 16.46\,MPa < 28.5\,MPa = \sigma_{calc}$. This means, maximum stresses induced in structure by external loads are admitted. For deformations it was noticed that $[w/t]_{calc} = 1.27 < 2 = [w/t]_{adm}$, meaning that deformations are also admitted.

7. It was noticed that the original structure is over dimensioned, as expected. Therefore, there is a possibility to reduce dimensions of the structure's elements in such a way as to consume less material than in building a ship. By reducing dimensions of the structure's elements their mass obviously decreases. Therefore, displacement and draught of the ship are also reduced.

These decreases have at least two effects. First, loads (pressures) applied on the structure are reduced and this leads to a reduction of stresses and displacements and therefore to possibilities to reduce dimensions again. A second effect is that the maximum speed increases because displacement decreases. Of course, in this case it is assumed that the same engines are kept. From the DNV calculus relations it is noticed that by increasing speed, calculus pressures do not increase. That is, by redesign, a new lighter and faster ship may be obtained.

Alternatively for the ship's building, a cheaper material may be used containing less glass fibre having of course a towing rupture resistance lower than $95\,MPa$. Considering maximum equivalent stresses and relations of their admittance according to DNV rules, one material may be used which has a towing rupture resistance of $3 \times 16.46\,MPa = 49.38\,MPa$.

In this case, one must consider that the registers of classification generally admit as an inferior limit for towing rupture resistance the value of $85\,MPa$. Reducing the glass fibre concentration in the composite used for building the ship has the effect of reducing the longitudinal elasticity mode of the composite which has a reduced effect on the stresses' variation.

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AN ATTEMPT RELATED WITH ACHIEVING ENGINEERING SKILLS FOR FUTURE MARINE PROFESSIONALS IN CMU

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ABSTRACT

Students enrolled in Constanta Maritime University, Navigation and Naval Transport Faculty, are trained in order to develop thermodynamic calculation skills within the seminar activity specific to the Thermodynamics course delivered to students in their first year of study, second semester.

This paper is describing a design case related with gas turbines. Students first receive a theoretical basis during the course and after that they are facing a calculus experience, being divided into subgroups. Each group gets its on set of input data and supervised till the end of the calculation.

The novelty of this calculus methodology consists in the fact that up to now, students worked individually, with the same initial data.

The group forming creates prerequisites for idea exchange, encourages teamwork, and stimulates the communication of obtained results.

At the end of this activity, it is possible to have a comparison and to identify the most convenient situation.

This approach is original since in order maritime environments, a similar calculus is not a subject of study submitted to students enrolled in the first year study, Navigation Faculty.

Keywords: *gas turbine, thermodynamics, navigation, calculus.*

1. INTRODUCTION

Constanta Maritime University (CMU) is an important provider of highly educated future professionals for marine transportation sector since it has a curricula designed in such a way that allows to graduates to demonstrate design abilities related with marine technologies [1].

This specific feature facilitates to face the challenge of training highly skilled marine officers in the context of economic crises and fast developing of the technology on board [2].

Thermodynamics is an important and quite difficult discipline in the curricula of any future engineer, since it provides knowledge specific to thermal and energy systems, starting with a substantiation relying on equation of state, property tables and charts [3]. This discipline is included also in the curricula of students enrolled in the Navigation and Naval Transport Faculty. The features of this discipline delivered in CMU are:

COURSE DESCRIPTION

A. IDENTIFICATION DATA

Course Title: THERMODYNAMICS AND THERMAL MACHINES
Course Type: specialty
Course Hours : 28 hours
Application hours :14 hours
Number of credit points: 2
Term: 2
Subject category: mandatory
Prerequisites: attending and / or passing the following subjects : mathematical analysis, physics, chemistry

B. OBJECTIVES

- course objectives: having theoretical knowledge for the application of thermodynamic laws in order to study processes developed in thermal plants
- application objectives: knowledge and calculus understanding and application delivered during courses, by solving specific problems.

C. SPECIFIC SKILLS

The capacity of translating into practice the theory gained during theoretical courses, obtaining solutions to specific engineering problems, the ability of communicating these results.

D. ASSESSMENT

a) written paper: 100 points
b)minimum requirements for participation to examination : attendance at courses and labs (80 %)

E. BENCHMARKING : presentation materials, drawings, lecture notes, Power Point

In this paper it is described the manner in which students are exposed to a calculus specific to gas turbines during the seminar activity.

The theoretical basis of this issue is provided to the students during the course; they are familiarised with the fact that nowadays gas turbines are technologies similar with internal combustion engines, being frequently used as power generating systems, the difference between them being related with the combustion process [4].

Although in the past time gas turbines were not attractive due to some drawbacks, as price, improved

technology and price policy put them in the right place in the eyes of ship owners [5]. For this reason, their rigorous study is very fruitful.

For the calculus, each group of students is divided into subgroups, each subgroup receiving a set of input data for the same gas turbine application. The analysis of the results will allow to the students to formulate conclusions on the different situations.

2. METHODS AND MATERIALS

The students are introduced in the application with the following text after which the subgroups receive the set of values for the calculus [6]. The professor assists the students in each stage of the calculation.

At the end of the calculus it is possible a comparison of situations.

Enunciation of the gas turbine application:

On board of a cargo ship works a gas turbine with the isochoric combustion of the fuel.

The air is compressed from $p_1 = ...bar$ and 40°C. The compression ratio of the compressor is $\varepsilon = V_1 / V_2 = 6$. The presure at the end of the combustion is $p_3 = ...bar$. The mass flow of the air in the compressor is D=..... kg/s.

To be determined:

- the power of the plant;
- the thermal efficiency of the plant.

Are known: the efficiency of the combustion room $\eta_a = ...$, the izentropic efficiency of the compressor and turbine $\eta_{izC} = 0{,}84$ / $\eta_{izT} = 0{,}87$.

It is considered that the working agent has the properties of the air, so: $c_p = 1{,}005 kJ/(kg \times K)$ and $c_v = 0{,}715 kJ/(kg \times K)$.

Solving steps:

Are noted as:

1- compressor suction;
2- compressor exit (theoretical process);
2'- compressor exit (real process);
3- combustion room exit;
4- gas turbine exit (theoretical process);
4'- gas turbine exit (real process).

Calculus of the work of compression:

$$l_c = c_p (T_{2'} - T_1)[kJ/kg]. \quad (1)$$

Calculus of the pressure after compression:

$$p_2 = p_1 \varepsilon^k = ...[bar]. \quad (2)$$

Calculus of the adiabatic exponent:

$$k = \frac{c_p}{c_v} = ... \quad (3)$$

Calculus of the temperatures after theoretical and real compression:

$$T_2 = T_1 \varepsilon^{k-1} = ...[K], \quad (4)$$

$$T_{2'} = \frac{T_2 - T_1}{\eta_{izC}} + T_1 = ...[K]. \quad (5)$$

It is possible to make substitution in the formula (1) and to get the result:

$$l_c = ...[kJ/kg].$$

Calculation of the power:

$$P = D \times l_u = D(l_d - l_c)[kW]. \quad (6)$$

Calculation of the work for expansion:

$$l_d = c_p (T_3 - T_{4'}) = ...[kJ/kg]. \quad (7)$$

Calculation of the temperature at the end of the combustion;

$$T_3 = \frac{p_3}{p_2} \times T_2 = ...[K]. \quad (8)$$

Calculation of the temperatures after the theoretical and real expansion:

$$T_4 = T_3 (p_1 / p_3)^{\frac{k-1}{k}} = ...[K]. \quad (9)$$

$$T_{4'} = T_3 - \eta_{izT}(T_3 - T_4) = ...[K]. \quad (10)$$

It is possible to find the value for the work and the power, by replacements:

l_d =.....[*kJ/kg*];

$$P = ...[kW].$$

Calculus of the thermal efficiency of the plant:

$$\eta_T = \frac{l_d - l_c}{c_v (T_3 - T_{2'})} = ...\% \quad (11)$$

Table 1. Input Data received by subgroups

Set of input data	p_1 $[bar]$	p_3 $[bar]$	η_a	D
1	0,95	22	0,99	46
2	0,90	22	0,99	46
3	0,87	22	0,99	46
4	0,80	22	0,99	46

3. RESULTS AND DISCUSSION

The results obtained when the pressure at the compressor inlet varies are given in Table 2. A comparison between the obtained results shows that together with the decrease of pressure p_1 the work of compression is almost constant, while the work for expansion increases.

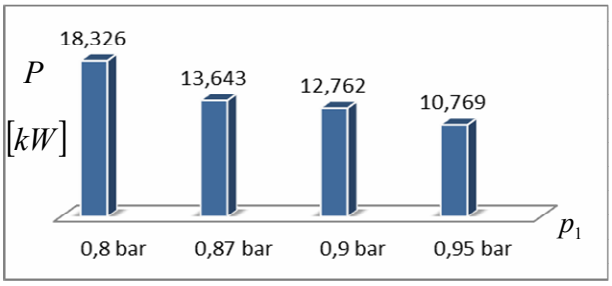

Figure 1 Power of the plant versus compressor inlet pressure

The highest values for the power of the plant and for the efficiency are obtained for the lowest value of pressure. For a better view of the results, in Figure 1 and 2 are given dependencies between the power and the efficiency of the plant and the compressor inlet pressure p_1.

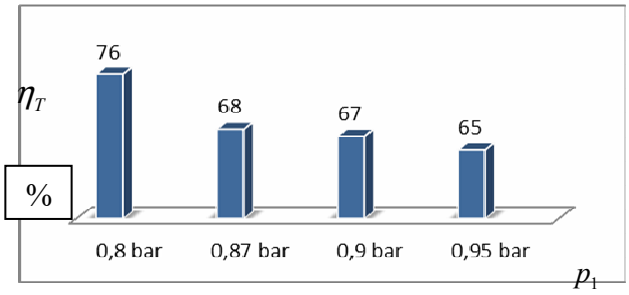

Figure 2 Efficiency of the plant versus compressor inlet pressure

Table 2. Results obtained for different values of p_1

p_1										
Results 1										
p_1 $[bar]$=0,95 p_3 $[bar]$=22 η_a=0,99 D=46	p_2 11,67 $[bar]$	T_2 638,82 $[K]$	$T_{2'}$ 700,85 $[K]$	p_1 T_3 1200 $[K]$	T_4 487,6 $[K]$	$T_{4'}$ 580,35 $[K]$	l_c 389,63 $[kJ/kg]$	l_d 623,74 $[kJ/kg]$	P 10.769 $[kW]$	η_T 65%
Results 2										
p_1 $[bar]$=0,90 p_3 $[bar]$=22 η_a=0,99 D=46	p_2 11,05 $[bar]$	T_2 638,82 $[K]$	$T_{2'}$ 700,85 $[K]$	T_3 1271,26 $[K]$	T_4 508,5 $[K]$	$T_{4'}$ 607,67 $[K]$	l_c 389,63 $[kJ/kg]$	l_d 666,9 $[kJ/kg]$	P 12.762 $[kW]$	η_T 67 %
Results 3										
p_1 $[bar]$=0,87 p_3 $[bar]$=22 η_a=0,99 D=46	p_2 10,68 $[bar]$	T_2 638,82 $[K]$	$T_{2'}$ 700,85 $[K]$	T_3 1320,24 $[K]$	T_4 532,29 $[K]$	$T_{4'}$ 634,73 $[K]$	l_c 389,63 $[kJ/kg]$	l_d 688,93 $[kJ/kg]$	P 13.643,658 $[kW]$	η_T 68%

Results 4										
p_1 $[bar]$=0,80 p_3 $[bar]$=22 η_a=0,99 D=46	p_2 9,76 $[bar]$	T_2 638,82 $[K]$	$T_{2'}$ 700,85 $[K]$	T_3 1430,28 $[K]$	T_4 529,2 $[K]$	$T_{4'}$ 646,34 $[K]$	l_c 389,45 $[kJ/kg]$	l_d 786,86 $[kJ/kg]$	P 18.326, 85 $[kW]$	η_T 76%

Are considered four situations, variable being the inlet pressure in the compressor of the gas turbine system, more specific, this pressure is decreasing.

After finishing the calculus, the subgroups present their results for comparison. The students are able to observe that with the decrease of p_1 the work specific to the expansion is increasing so as the power P.

4. CONCLUSIONS

Gas turbines are techologies wide spred in marine transportation sector due to their benefits. In order to be able to deal on board with high responsability, students enrolled in Navigation and Naval Transport Faculty in CMU are exposed to a calculus experience on this topic.

Our first year students have the opportunity to develop skills and expertise in gas turbines technologies by teamwork which allows the achievement of the goal, by the exchange of knowledge cannot be created by the simple assurance of individual work. In comparison with individual work, the teamwork provides conditions for better results communication, in a more effective duration, and also a more visible comparison of obtained results.

Our students are dealing with a thermodynamic calculus and by varying the pressure at the inlet of the compressor results several sets of results, being possible to see in which situation the power of the plant and the thermal efficiency are higher.

The best values for the plant's power and efficiency are get for the lowest value of the pressure at the inlet of the compressor (0.8 bar) meaning P=18.326,85 $[kW]$ and η_T = 76 %.

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A POINT OF VIEW ON SKILLS AND COMPETENCIES IMPROVEMENT PATHWAY FOR WORKERS IN RES

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ABSTRACT

Given the fact that renewable energy systems are clean sources of energy, at the hand of humanity, presenting a more friendly impact on the environment related to the conventional ones and good efficiencies, these systems are very attractive not only for stakeholders but also for the public.The fast development of the RES sector is related with the building and maintaining the facilities, this situation leading to the need of workers able to deal with this technology.
Romania and Bulgaria are facing the lack of workers with specific skills in RES, this is why this paper is dealing with the Romanian point of view on this issue, as an achievement of a two days workshop dealing with the workforce for renewables and their specific skills and competencies, organized as an activity of the project GREEN ENERGY CLUSTER CONSTANTA- DOBRICH, within Romania Bulgaria Cross Border Cooperation Programme 2007–2013. This point of view is the result of the work of the participants in the workshop, respecting the EASW Methodology (European Awareness Scenario Workshop). The participants represented different categories with interests in RES: students, experts, stakeholders and policy makers.

Keywords: *renewables, cross- border, skills, competencies.*

1. INTRODUCTION

The project "Green Energy Cluster Constanta–Dobrich" was implemented due to the partnership between a Bulgarian ONG- Varna Business Agency and a public Romanian university- Constanta Maritime University, within Romania Bulgaria Cross Border Cooperation Programme 2007–2013. The overall objective of this project is to ensure sustainable favourable conditions in the Romanian- Bulgarian cross-border region for both catalyzing mastered growth of the regional environmentally friendly energy industry and maximizing the clean energy potential of local industries, federating expertise, knowledge and resources- human and material, from these two countries by the establishment and development of a Triple Helix type Cross-border Green Energy Cluster "Constanta-Dobrich" [1].

The physical base of different renewable energy sources which is available all over the world is huge, the specific technology being able to provide greener and more sustainable methods of meeting the need for energy compare with conventional fuels; internationally, the recoverable resource surpasses the request for commercial energy by a factor of more than 100 [2].

Having in view the advantages offered by the renewable energy systems and their popularity, the science connected with them is in continuous development.

In this framework, it is obvious the need for personnel with specific skills and competencies, able to deal with the future renewable energy sources and as well with the highly improved efficiency of existing ones, since the potential of finding jobs in this sector is very attractive. An other important aspect is related with the fact that investments in this sector depends strongly on the adequately trained workforce [3].

Within the last work package of the project were organized two mirror workshops, in the both countries, related with workforce for renewable, aiming the finding of skills and competencies improvement pathway. This paper reveals the point of view of the participants in the Romanian event, formulated at the end of the workshop, after working according to a methodology explained briefly in the following.

2. METHODS AND MATERIALS

In order to formulate a common point of view of all the participants in the workshop in respect with the skills and competencies improvement pathway specific to RES in the analyzed cross border area, was used the EASW Methodology (European Awareness Scenario Workshop). This methodology was seen to be appropriate to this workshop because it is suitable for a two days event, with an attendance of 30 persons (as in our case), participants coming from four different social categories, aiming opinions exchange, different visions assessment, obstacles identification and solutions statement [4].

Following the methodology, the workshop was developed on splitting the participants in four groups: Students Group, Technology Expert Group, Private Sector Group, Policy Makers Group. To each group was given the task of working on worksheets. The worksheets invited participants to answer to eleven questions and to rank priority areas for intervention with concrete measures for change.

The questions addressed to the four groups were as follows:

1. How can increase the number of jobs in RES in the cross border area and which should be the selection criteria for the employers?

2. How can education and training systems be adjusted better in order to face the real need of RES industry in the cross-border area?
3. What are the results of the lack of skills in RES development registered in the cross-border area?
4. What measures can be taken to gefine more accurate new jobs/skills related to RES business requirements and to make green jobs more attractive, particularly for young people, and also to stimulate entrepreneurship in this field?
5. Which are the top priorities for technological solutions related to green energy able to create the new jobs in the cross-border area?
6. What do you see to be the main RES jobs challenges nowadays?
7. What are the barriers to RES sector development (Awareness? Perceptions? Skills? Profitability? Incentives?) and how can they be overcomed?
8. What are the key policy tools and instruments that could help foster the green jobs growth in the cross-border region?
9. Analyze the role that interest groups play in the policy-making process. Who will initiate the change? Who will help spread the message?
10. How could a cluster, as a whole, achieve greater investment into green economy of the region as driver of job creation?
11. From where could one find information about RES jobs?

The priorities to be ranked were: identification of the relevant occupations, definition of training needs and setting up training and qualification pathways, recruitment for sustainable development jobs, promotion and development of the occupations for green growth.

3. RESULTS AND DISCUSSION

In the following are presented the answers given by the members of the groups. They were presented by a moderator selected from each group.

Below are given the answers of **Students Group.**

This group found that the main points on question number 1 are: the development of technical/practical education in the field; improving the legislation into developers favour; the candidate who has been long time trained in RES area should have priority in front of those who has been short time trained.

The answer to the question number 2 of this group is: introducing elementary knowledges from secondary school. They also identified the foundation of new training centres supported by those who are looking for staff, programs of training after a basic instruction.

The Students Group replies to the question number 3 that the lack of qualified personnel is a real problem since companies try to simplify the recruitment procedure.

On the question number 4, the students wrote that the main ways to create new jobs in the RES field are: increasing of investments done by young people, a sustainable integration on labor market of the young jobless unqualified persons, and boosting staff involvement.

For the question number 5, the Students Group had the following answers: updating the education system and the level of trainings to the nowadays demands, the unemployed should be the main beneficiaries of these courses. To the question number 6 this group answered: the newness and complexity in the RES field. The responses for the question number 7 pointed various problems like: the lack of green education and promoting the positive results of the RES sector; the actions/ programs of government are not correctly applied to boost the green economy, so it is necessary to involve businesses sector and the consumers in order to stimulate the interest of using ecological products and services.

The answers to the question number 8 resulted from this group were: financial support of training programs for new occupations and skills in the RES field, European fundraising, attracting viable partners. The group has analyzed the question number 9 and they note: the cooperation between different kinds of specialists (academics, researchers, consultants, public administrators, experts) contributes in finding the alternatives and solutions in RES area.

The public society has an important role in the development of RES area because it can propose many recommendations, since it has interests in costs and health.

The entity that will disseminate the message can be a new created cluster (Green Energy Cluster), as an output of the project. The change can be initiated by the civil society who is in strong connection with the local authority. The group gave to the question number 10 many answers as: creating interconnections between civil society, authorities, school and the economic environment; the new created cluster can facilitate the access to founds and can provide consultancy related to RES. The question number 11 revealed solutions as: internet, books (documents/ scientific articles), educational systems, Chamber of Commerce, business environment.

Private Sector Group replied the followings:

On question number 1, the Private Sector Group thinks that is important the following: the development of the RES industry by qualification and increased experience.

For question number 2, they consider that it is necessary to exist an interconnection between the system of education and the National Agency for Employment.

Related to question number 3 were noted: occurrence of damages/ defections, the long time for resolve the damages and the high costs for maintenance.

For question number 4, one of the measures that can be taken is to introduce the specialization modules.

In respect with question number 5, the Private Sector Group found as a priority for technological solutions to have an educational system remodelled for new competences necessary in RES sector.

This group found, for question number 6, that the today jobs` challenges are using high tech and motivation by salaries.

Question number 7: the barriers to RES sector development are legislative incoherence, the lack of predictability in economic and business sector on medium and long term and, most important, they identified the incorrect competition in the sector.

Question number 8: the Private Sector Group concluded that the key policy tools that could help the green jobs growth are development of RES industry; experience and specialization (working with experts).

Related to question number 9, when the Private Sector Group analyses the role that the interest groups are playing in the policy-making process, they stated that the initiation of change should be done by the new created cluster (Green Energy Cluster), the educational institutions, the local and national authorities. After that, the Green Energy Cluster and the NGOs have to spread the information/ message.

At question number 10, they replied that the cluster must contribute to the green economy of the region. It can make known all the problems from this sector to EU and make lobby regarding the advantages and opportunities of using green energy in the cross-border area.

Finally, for question number 11, they think that the information about RES jobs can be found directly from the companies dealing with development, implementation and maintenance in RES sector and through the green energy cluster.

The point of view of Technology Experts Group was that:

For the question number 1 the Technology Experts Group stated that the methods to increase the number of RES jobs in the area are: to exploit wiser the resources in the area, to adapt the legislation in the domain to the economic realities and also to upgrade the energy management system; to use an accurate employment recruitment criteria for Level 3 of qualification (electrical/ mechanical/ electromechanical), the existence of specific selection criteria for each company, according to the personnel management.

The answer for question number 2 given by the Technology Experts Group is: to introduce in the Romanian Nomenclature of Qualifications (COR), the qualifications specific to RES, but also changing curricula by introducing RES information for gaining skills in the field, for different level of education.

For the question number 3, the Technology Experts Group stated that, nowadays, there is no specific qualification range, that is why it is used personnel qualified in connected fields, with training at the working place, depending on the requirements of each job. Factors as: increasing the duration of repair, obstacles related to the development of a project, and also reduced service opportunities in the filed represent the results of the lack of skills in RES development in cross-border area.

In the vision of the Technology Experts Group, the answers for the question number 4 were: to develop schemas and strategies in order to stimulate the domain and the structures, to make publicity and increase public awareness.

For the question number 5, the Technology Experts Group noted the development of training standards/ occupational standards specific to RES, establishment of a local office of the cluster and keep it working, development of the information base through technology transfer and documentation, and also through the information campaign.

The answers came from the Technology Experts Group at the question number 6 were: lack of experience and complexity of the field, the slow development of the field, lack of information, deficiencies of the legislation in this area.

For the question number 7, the Technology Experts Group stated that the barriers to RES sector development are: the lack of a specific education in the field, unstimulating legislation, high costs of implementation and maintenance, the miss application of existing legislation.

Question number 8: the key policy tools and instruments that could help foster the green jobs growth in the cross-border region: the development of the infrastructure in this area, the labour migration. Question number 9: NGOs, civil society and the educational system are the main factors that will drive change. But also, the EU legislation and the national legislation can drive the changes. The field projects and the information campaigns are also important factors.

At question number 10, the Technology Experts Group answered that the interrelationship of interests should be the main activity, leading to increasing visibility and promotion of the common interests.

For the last question, the Technology Experts Group thought that there is a lack of public information on occupations in the field, so the information can be taken only from the employers, and partially from the Internet and literature.

The Policy Makers Group noted that:

Question number 1: intellectual preparation and readiness of students for technical and scientific retraining at a superior level. It will take into account the individual's ability to learn and also its adaptability.

The Policy Makers Group stated, for the second question, that definitelly must be a correlation between supply and demand; specialists have to be trained within companies which are producing/ selling these systems and those using them.

From analyzes made by regional authorities, for the question number 3, this lack of qualification is not a major issue in the present, but it appeared in the first phase of the RES sector development.

For question number 4: development of a training school and training institution in the field, the existence of a working contract which must be performed for at least 3-5 years, developing collaboration between the private and public sectors, European fundraising to develop entrepreneurship in the field.

In the Policy Makers Group conception in respect with question number 5: exchanging best practices, popularization of the systems in the field of RES, publicity by local authorities of training centres activating in the field of RES, promoting of active measures on the labour market should be an element of

modern public policies for the Romanian system. There are some methods: information, mediation, counselling and training. Training is intended mainly young people, who have the overall objective of employment. It is also needed to increase the transparency of the labour market and human resource development in the field.

The Policy Makers Group noted for question number 6 that todays' main RES jobs challenges are the high professional responsibilities, training courses at highest level in RES sector and the use of advanced technology.

Question number 7: the lack of skills in RES for different level of education, high costs of some training courses available on the market.

Question number 8: the key policy tools and instruments that could help foster the green jobs growth in the cross-border region are namely the advanced technology investments, clarification of legislative policy procedures in order to facilitate the development in RES sector and fundraising activities.

In the vision of Policy Makers Group, for the question number 9, renewable energy policy change occurs from government policy and its implementation at the regional level, depending on the needs of the area. Spreading the message will be made by local authorities and institutions, and developers in this area.

For question number 10, this group noted that a cluster can contribute at raising investments in RES sector by reporting bureaucratic impediments, registered locally and also nationally levels. The cluster, as a driver of green job creation, has to be the connection between the business sector and local/central authorities.

Finally, the Policy Makers Group stated, for the question number 11, that the information can be taken from the companies activating in the field of RES and also, from the authorities for employment.

The groups had to define thier priorities and resulted the following:

- The Students Group has prioritized the following aspects:

Priority 1: Definition of training needs and setting up training and qualification pathways;
Priority 2: Identification of the relevant occupations;
Prority 3: Recruitment for sustainable development jobs;
Priority 4: Promotion and development of the occupations for green growth.

- The prioritization by the Private Sector Group vision was:

Priority 1: Promotion and development of the occupations for green growth;
Priority 2: Identification of the relevant occupations;
Priority 3: Definition of training needs and setting up training and qualification pathways;
Priority 4: Recruitment for sustainable development jobs.

- In the point of view of Technology Experts Group, the priorities are:

Priority 1: Definition of training needs and setting up training and qualification pathways;
Priority 2: Identification of the relevant occupations;
Priority 3: Promotion and development of the occupations for green growth;
Priority 4: Recruitment for sustainable development jobs.

- The Policy Makers Group has prioritized the following aspects:

Priority 1: Definition of training needs and setting up training and qualification pathways;
Priority 2: Identification of the relevant occupations;
Priority 3: Recruitment for sustainable development jobs;
Priority 4: Promotion and development of the occupations for green growth.

4. CONCLUSIONS

In the present time, when RES sector is so attractive for the society and for business, to have adeqautely trained workers is vital. This paper revealed the pathway of achieving this, obtained as a result of a specific workshop organised as an activity of the cross- border project "Green Energy Cluster Constanta–Dobrich". The participants in the workshop were coming from different categories were divided into groups and they had to work on worksheets having a part with addressed questions. The resulted answers were presented by moderators representing each group, thus being possible for all the participants to have idea about the opinions of others. The answers to the eleven questions and the priorities ranking revealed the fact that on the same topic, the formed groups provided different answers, a normal situation due to the fact that each group have his own specific interest in RES. Presenting the answers of each group in front of the others made possible the discussion between different categories and resulted a form of the different point of views, which was presented in this paper. This form was turned into a statement which have been disseminated between the members for the Green Energy Cluster from the both countries.

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BIODIVERSITY, VARIETY, UTILITY, CONSERVATION RATE IN THE SUBCARPATHIC AREA BETWEEN BUZAU AND RAMNIC

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ABSTRACT

The structure and spatial sizes of this component of Subcarpathians between Buzau and Ramnic, reflects the close relationship between man and this factor in particular, with profund implications not only on the aspect and general dynamics of the landscape, but also on the economy of the area and on people lives. The natural greenary of Subcarpathians between Buzau and Ramnic belongs to the mesophilic deciduous forests ,oak grove, forest steppe and steppes. The vegetations characteristic of the Subcarpathians between Buzău and Râmnic is representend by the lack of mesophilic oak grove, these being represented by penduculated oak forests. They occupied the central and south-east part of the region , but they were deforested and replaced by farmlands and meadow steppes.(tefănescu I., 1972).

The faunal structures of the hills show the same features of interpenetration and mixture of mountain and field fauna. The fragmentation of the landscape, the nature of the rocks, the microclimate, the plants associations – generated the pedogeographic mosaic carpet.

Keywords: *deciduous forests, oak groves, evergreen oaks, forest steppe, sandy soils.*

1. INTRODUCTION

In the mesophilic deciduous forests , which occupy most of the area, we can identify three sublevels, namely:

The sublevel of resins and beech tree mixed forests with different uneven distributed communities: *Abies Alba* (the fir tree) and *Picea excels* (the spruce fir) on the Ivane ului northern plants and *Fagus silvatica* (the beech tree) on the southern plants. Thes sublevel exceeds the northern limit of the analizea subcarpath area, there for still appear coniferal.

The beech forests sublevel cover most of the interpenetration carpato-subcarpathic area of Valea Buzaului, Plaiul Nucului, Braesti. The forestry is represented by Abies pectinata (the fir tree), Acer pseudoplatanus(the mountain sycamore maple) and *Ulmus montana* (the mountain elm tree). The underdeveloped foresty is represented by *Evosymus latifolia* (the spindle) and *Daphne mezereum* (the spurge olive) (Petrescu- Burloiu,1997)

The subblevel of the evergrun oaks is well represented on the Salcia Hills, Panatau, Valea Slanicului, Bocului Hills, Lopatari and Rusavat.

2. MATERIALS AND METHODS

The most important faunnistic and hunting element is the deer (*Capreolus capreolus*) very well represented in the studied area. The wild boar (above sow) is a valuable cynegetic specie with a big density in the beech forests and in the evergreen oaks from the hunting fund area in Brăeşti, Cislău. The Carpathean stag (*Cervus elaphus)* and the brown bear (*Ursus arctos*) are located mostly in the contact area Carpatho-subcarpahtic contact area.The capercaillie (*Tetrao urogallus*) is a true cynegetic beauty and we can finit in the northern part of the area. (Pătroescu M., 1982).

In the studied area, soils are varied on completely restricted areas, due to landscape, fragmentation rocks consistency, microclimate and different vegetal unions, being affected by degenerations with varied force and frequency. These terms connect and influence the distribution, characteristics but also their fertility level. Spatial distribution of the soils, related to relief elements, vegetation etc. all these record the Subcarpathic landscape with a specific character.

The Subcarpathians between Buzău and Râmnic have a hills fauna characteristic for the bech and oak forests in we can su mixed that mountain and steppe elements .The evergreen oaks are made up of three species: *Quercus petraea, Quercus dalechampii, Quercus polycarpa. Beside these deciduous* trees, we can also find *Quercus robur* (the oak), *Acer platanoides* (the Norway maple), *Malus sylvestris* (the crabapple), *Pyrus piraster* (the amelanchier) (Petrescu- Burloiu,1977).

The study of vegetation and fauna has been conducted thoughout the study area an dis based on its own research,descriptions,observations made in the field during the years 2013-2016. Research methods of the plant based on criteria developed by Braun- Blanquet scale (1964), adapted by Borza and Boscaiu (1965), the specific characteristic of the vegetation of the area of study. Quantitative criteria in the study of the abundance, and dominance were individuals, according to Braun-Blanquet scale system supplemented by Tuxen and Ellmberg(1937). In the study of fitocenologic,an environmental associations,we have paid particular attention to the analysis and compozition of floristic elements,broken down categories of organic moisture,temperature, after the chemical reaction of soi land genetic structure. In the vegetation study, we adopted asa unit sintaxonomic basic plant association(

Gehu- et Rivas- Martines,1981). Identification separation associations were made the criterion flora, dominant species illustraded,typical,differential and recognition.

The results obtained were analysed and rendered in the form of grafhics,histograms and diagrams.

3. RESULTS

The shrub layer is well developed : *Curylus avellana* (the hazelnut), *Rhamus cathartica* (the buckthorn) ,*Ligustrum vulgare* (the wild privet). We can also find *Carpinus betulus* (the hoarnbeam), *Tilia cordata* (the linden tree), *Fraxinus excelsior* (the ash tree), *Ulmus foliacea* (the elm tree).

In these trees area, the shrubs layer has a wide floristry component, being made of *Cornus mas* (the cornelian cherry), *Sambucus nigra* (the elder tree), *Cretaequs monogyna* (the hawthorn).

One of this area is characteristics is the presence of the intra-zone steppic associations developed on the eroded soils. These associations are made of: *Stipa capillata, Stipa joanis, Andropogon ischaemum*. In the south and southern and south-eastern area of the Subcarpathians between Buzău and Ramnic we can fiind the forest steppe area, in the form of a narrow zone which covers Blajanilor Piedmont southern and south-eastern slopes. We can see forests in the form of penduculated oak clusters, the pubescent oak (*Quercus pubescens*) and the French oak (*Quercus pendunculiflora)* (Pătroescu M., 1996).

The steppe coming from south, is made of blackthorn clusters (*Prunus spinosa*) and the Russian almond (*Amygdalus nana*), excepting its own elements. Along the rivers, near the white alder riverside coppices, we can also see the black alder (*Alunus glutinosa*), the poplar trees (*Populus alba, Populus ni*gra) and the saltcedars (*Tamarix ramossissima*). On the meadows fields there are a lot of mesophilic and absorbing species with: *Agrostis alba, Lolium perenne, Rumex crispus, Mentha palustris, Potentila reptans* .

The submediteranean elements constitutes an important feature of the vegetation in the Subcarpathians between Buzău and Râmnic and they appear among the forest steppe oaks groves on the southern exposition slopes. The ash tree (*Fraxinus ornus*) can be seen on the follouring valleys: Balanesei, Slanicului, Niscovului and Sibiciului. The smoketree (*Cotinus cog*gygria) appears in Policiori, Grabicina, Cernatesti, Lopatari. The common lilac (*Syringa vulgaris*) forms associations in some areas in Paclele - Cernatesti region(Muică C. 1983)

In the faunal complexes we can find a series of submediteraneen elements,wich reflects the special topoclimatic conditions . The scorpion (*Euscorpius carpaticus)* is representative and be seen in Gura Valley,Lopătari. The wolf (*Canis lupus*) is present in and all hunting stocks, just as the wild cat (*Felix silvestris*) or the polecat (*Mustela speciae*) .

The Lynx (*Linx linx*) on endangered predator of the Carpathians,can also be seen in the Subcarpathians between Buzău and Râmnic in the rocky forests in the following stocks: Bisoca , Vintilă Vodă, Brăeşti.

The rabbit (*Lepus eu*ropaeus) wide spreaded in Braeşti, Vintila Voda, comes from the field up to the mountain area. The grey partridge (*Perdix perdix*) presents a small area in the mingling zone of the hills and fields (Cozieni, Policiori, Beceni). Both the rabbit and the grey partridge form the most important hunting element, both from economical and sport hunting point of view (Pătroescu M., 1996).

The zonal soils, imposed by the altitude and climate(brown and brown podzolic) receive the intra-zone soils related to the rock (rendzinas and pseudorenzinas), slope and accented moisture, relief microforms (meadow soils), etc.

In the north, at the contact with the mountain area, are develops podzolic soils. In the eastern part from Buzau, we can see apart from the brown soils, yellow-brown soils and podzolic argilic solis in different degreses of degradation. The existence of the rocks with a rich content of salt,determins local, the existence of the salty soils (in Lopatari valley Sibiciului, Policiori). The slopes base, consisted of marl with casts and dacitic tuffs, are covered with forest brown soils and pseudorendzines (Petrescu – Burloiu,1977).

In the eastern part of the Sibiciu - Brăeşti - Lopatari bassin coridor,an important element is reprezentend by the regosols,that can be found significant both in Buzăului and Slănicului basins, but especially in Bălăneasa and Saratel, Berca basins where they present a wide development. Less developed are the meadow hayfield black soils. They develop on marl or clay,under the deciduous forets. They are often associated with the pseudorendzinas and the cover the eroded and slippery hill slopes in the western area of Sibiciu- Brăesti-Lopătari depresion, Policiori depresion.

The acidic brown forest soils are less spread, especially on the interfluves in the following area: Panatau, Ursoaia, Balaneşti - Botanu and Saruleşti. In the south- eastern parth of Buzăului Subcarpathians, the podzolic brown soils appear sporadically, wide surfaces being occupied by dark grey soils,which develops isolated on thesandy roks and loess, especially on Muchea Săpocii and Blăjanilor hills. (Pătroescu,1996).

In the Paclele Mari area, on the young relief, appears intra-zone pre-steppe soils ,sandy or loess soils.

On the whole area of the Subcarpathians between Buzău and Râmnic the present shape processes represented by the landslides, slow gravitational movement, surface erosion are possible due to some favourable conditions, but also due to negative interfere of the human being, manifested especially by clearing of land,intensive grazing and improperly ploughting. Regarding the way in wich the biodiversity is used, there is a constant preocupation from the human colectivity, but,in the same time, there is also of conservation; we can fiind these aims in well known laws and rules.

4. CONCLUSIONS

On the whole area of the Subcarpathians between Buzău and Râmnic the present shape processes represented by the landslides, slow gravitational movement, surface erosion are possible due to some favourable conditions, but also due to negative interfere

of the human being , manifested especially by clearing of land,intensive grazing and improperly ploughting. Regarding the way in wich the biodiversity is used, there is a constant preocupation from the human colectivity, but,in the same time,there is also of conservation; we can fiind these aims in well known laws and rules.

The landscape fragmentation, interacting with thermal inversions and the foehn processes of the air mass led to the existence of numerous stationary conditions, which determined the mosaic of the vegetal cover, the altitudinal descent of some mountain elements and the mixture of the bush hand oak grove forests and with termophilic elements .The negative antropic actions led to the appearance, which contributed to the disorder of the structure and the evolution of the vegetable formations.

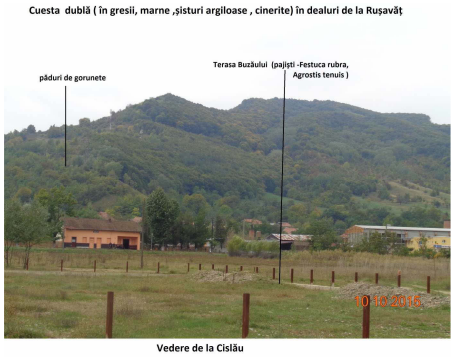

Figure1 Wiew from Cislau

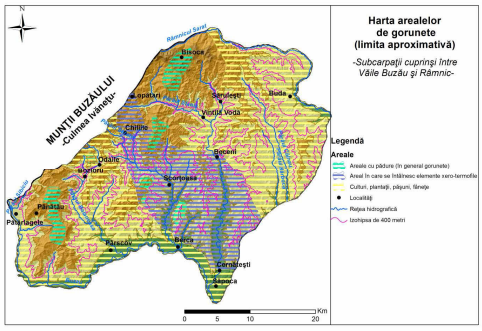

Figure 2 Evergreen map areas in Subcarpathians between Buzău and Râmnic

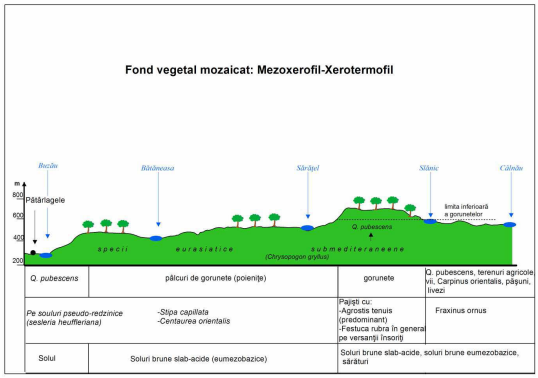

Figure 3 Vegetable mosaic background in Subcarpanthians of Buzău and Râmnic

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THE COMBUSTION OF A MARINE HEAVY OIL-WATER EMULSION DROPLET WITH LOW NOX EMISSIONS INVESTIGATED WITH GRAPHOLOGICAL METHOD

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ABSTRACT

The combustion graphology of fuel oils is defined as a new technical and scientific field which deals with the graphic transposition of the processes of fuels combustion development in a simulator. Thus, it is easy to establish the ignition-combustion characteristics, including the laws that govern their changes depending on the combustion conditions and fuel specifications. The introduction of water into the combustion chamber reduces the combustion temperature due to the absorption of energy for vaporization. Thus, the humidification can reduce the NO_x emissions. The vaporization and combustion characteristics of a marine heavy oil-water emulsion droplet are investigated with graphological method.

Keywords: *marine oil-water emulsion, vaporization, combustion, graphological method.*

1. INTRODUCTION

The combustion graphology of fuel oils is defined as a new technical and scientific field which deals with the graphic transposition of the processes of fuels combustion development in a simulator [Ghia, 1991]. Thus, it is easy to establish the ignition-combustion characteristics, including the laws that govern their changes depending on the combustion conditions and fuel specifications. The graphic representation of the combustion processes development for a droplet of liquid fuel used in the industrial combustion may be made by means of the so-called "combustion oscillogram" (Fig. 1).

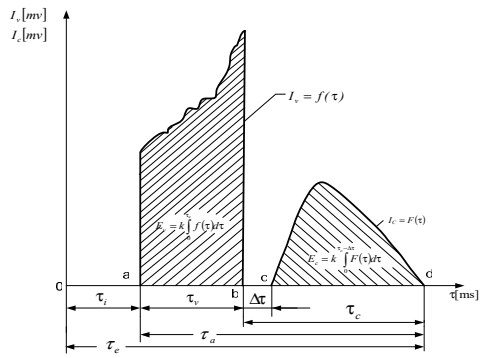

Figure 1 Graphic representation of the combustion processes development for a heavy oil droplet

This graph specifies the time variation t of the light-thermal energy radiation intensity I, for a burning droplet, transformed into electric signals by means of an optical-electronically system, equipped with a photoelectrical cell [Jianu, 1996], [Popa & Iscrulescu 1983]. Thus for a marine heavy fuel oil this ignition and combustion graph establishes, in standard conditions the self-ignition delay τ_i, the volatile matters combustion time τ_v, the cenosphere combustion time τ_c, the maximum radiation intensity obtained at the combustion of the cenosphere I_c^m, the maximum radiation intensity obtained at the combustion of the volatile matter I_v^m, the energy radiated by the burning cenosphere transformed by the photocell into electric energy E_c, etc. This paper deals with finding new methods and means for improving the combustion processes of marine liquid fuel. It tries to make evident the effects of water emulsion on the marine liquid fuel during combustion. The assessment of emulsification influence was made by comparing the combustion performance and the results with those obtained in the absence of emulsification under the same test conditions [Jinescu, 1983]. The laboratory researches developed on the isolated droplet burning had in view to state the measure in which the emulsification would interfere for carrying on the secondary atomization [Law, 1997]. We also tried to determine the characteristics of induced flames following their configuration and radiation, and to assess the igniting and burning behavior of droplets by laying down comparison criteria of the following times: τ_i; τ_v; τ_c; τ_a; E_v; I_v; E_c; I_c; the simplex of temperature combustion S_a; and the ignition ratio ψ.

2. THEORETICAL CRITERIA ON THE BOIL-UP AND COMBUSTION RATE OF LIQUID FUEL DROPLET

The need for increasing the degree of marine fuel combustion with and without researches, through which I can mention that of applying the water emulsion to the atomized fuel combustion. This paper deals with finding new methods and means for improving the combustion processes of marine liquid fuel. It tries to make evident the effects of water emulsion on the marine liquid fuel during combustion. The assessment of emulsification influence was made by comparing the combustion performance and the results with those obtained in the absence of emulsification under the same test conditions. The laboratory researches developed on the isolated droplet burning had in view to state the measure in which the emulsification would interfere for carrying on the secondary atomization [1]. I also tried to determine the characteristics of induced flames following their configuration and radiation and to assess the igniting and

burning behavior of droplets by laying down comparison criteria of the following times:

τ_i - self-igniting delay time;

τ_v - burning time of volatile matters old;

τ_c - burning time of cenosphere.

Self-igniting delay time τ_i

The physical model for theoretical calculation of self-igniting time [1]:

$$\tau_i = \frac{\rho L_v (r_0 + r_i)}{\varphi_r C_r \left[\left(\frac{T_m}{100} \right)^4 - \left(\frac{T_0}{100} \right)^4 \right] + \alpha_c (T_m - T_0) + \gamma C_a Q} \quad ..(1)$$

The theoretical expression of time τ_i shows that its value can be decreased by increasing the ambient temperature of droplet, the coefficient of heat-transfer from the gas flowing around the droplet to its surface, the oxygen concentration of droplet environment, the constant of reaction rate, the quantity of heat released up to flame ignition and by decreasing of the droplet starting diameter as well, the latent heat of vaporization and the liquid fuel density.

Burning time of droplet τ_a

The burning of residual fuel droplet is achieved in a period of time given by [1]:

$$\tau_a = \tau_v + \tau_c, \text{ [s]}, \quad (2)$$

where:

τ_v is burning time of volatile matters;

τ_c is burning time of cenosphere.

The life of droplet τ_e is longer than the burning time because it also includes the self-igniting delay time τ_I.

$$\tau_c = \tau_i + \tau_a, \text{ [s]}. \quad (3)$$

The liquid fuel droplet is considered a porous sphere in the middle of which the liquid volatile matters are concentrated. By vaporization and porous mass diffusion the volatile matters get out of lattice and burn. After consuming of volatile matters, the carbon porous lattice also burns due to the oxygen diffusion from the environment to its surface.

Burning time of volatile matters τ_v

Based on the used physical model, the theoretical relation for calculating the burning time of volatile matters was determined [1]:

$$\tau_v = \frac{\rho_v \left(\frac{M_v}{100} \right)}{8C_0 \frac{P_0}{\mu_v}} d_o^2 = \frac{d_0^2}{K_v}, \quad (4)$$

where:

p_v is the density of liquid volatile matters $[\mathrm{kg/m^3}]$;

M_v - the content of volatile matters $[\%]$;

μ_v - coefficient of dynamical viscosity of volatile matters $[\mathrm{kJ/kgK}]$;

d_0 - starting diameter of droplet;

C_0 - on the surface of porous lattice where $r = r_0$ the volatile matter concentration is zero $c = 0$ and for $r = r_v$ the concentration is $c = c_0$;

K_v - vaporization constant of volatile matters, depending on the chemical analysis of liquid heavy fuel and the characteristics of oxygen carrier medium as well. Decreasing the time τ_v is made by reducing the starting diameter of droplet and by increasing the ambient temperature as well and the starting diameter of droplet decreases by increasing the content of volatile matters in the fuel.

Burning time of cenosphere τ_c

After burning of volatile matters the carbon spherical porous lattice with diameter d_c remains which burns at the surface due to the oxygen diffusion from the environment to it [1]:

$$\tau_c = \frac{\rho_c \left(1 - \frac{M_v}{100} \right)}{3\rho_0 D_0 C_a \left(\frac{T_m}{T_0} \right)^{0,75}} d_c^2 = \frac{d_0^2}{K_c}, \quad (5)$$

where: ρ_c - density of cenosphere $[\mathrm{kg/m^3}]$;

ρ_0 - density of gaseous fluid;

D_0 - diffusion coefficient of nitrogen at $T_0 = 273$ [K], $[\mathrm{m^3/s}]$;

T_m - absolute average temperature of gaseous fluid surrounding the droplet $[\mathrm{K}]$.

The burning time of cenosphere τ_c decreases with temperature rise and concentration increase in oxygen of the environment around the droplet and with the increase of the diffusion coefficient of oxygen as well [1]. The self-igniting delay time of cenosphere τ_{ic} was experimentally perceived by time elapsed from the flame vanishing of volatile matters to the self-igniting of carbon residues.

$$\tau_c = \tau_I + \tau_v + \tau_{ic} + \tau_c. \quad (6)$$

3. THE WATER/HEAVY FUEL EMULSIONS COMBUSTION OSCILOGRAMS

I have made the combustion oscillogram for marine heavy fuel RMF35 with its characteristics mentioned in table 1, at which the water emulsification included four determination tests for water – marine fuel emulsion in proportions of 6[%], 11[%], 15[%] and 21[%]. At the combustion of water – marine fuel emulsion with a water percent of 40[%], the combustion becomes unstable.

In Figures 2 and 3, there are synthetically presented the experimental results. Each point marked in diagrams represents the arithmetic mean of six determination tests.

Table. 1. The characteristics of marine heavy fuel RMG35

CARACTERISTICA	RMG 35
Volumetric mass at 15[C], [kg/m^3], max.	998,0
Kinematic viscosity at la 100^{0}C, [mm^2/s], max.	28,0
Ignition point [C], min.	61,5
Flow point in [C] - winter, max. -summer, max.	32 34
Coked residue,[%g/g], max.	24
Ash, % [g/g], max.	0,17
Water , % [v/v], max.	1,2
Sulphur , % [g/g], max.	5,2
Vanadium , [mg/kg], max.	503
Aluminium plus silicon, [mg/kg], max.	83,5
Existing total sediment, % [g/g], max.	0,14

Based on the data obtained it results that by emulsifying the RMF35 fuel with water from 0 to 20%, we obtain:

- the increase of self–ignition delay τ_i from 515[ms] to 1181[ms];
- the decrease of lower heating power Q_i;
- the maximum temperature variation T_f during the ignition processes;
- from the rate of curves τ_v = f(w) and τ_c = F(w) it results that in the emulsifying range 0 – 10[%] water the fastest decrease of times τ_v and τ_c appears; so it is recommended an average emulsifying value of 5 – 8[%];
- as the substitution of a fuel part for water reduces the combustion temperature once the vaporization of emulsified water needs an additional energy consumption, it is recommended that we should have an average value. The decrease velocities of times τ_v and τ_c respectively, that is the ratios $d\tau_v$ /dw and $d\tau_c$ /dw depend on the characteristic of emulsifying system used, namely, the smaller diameter of water drops in the resulted emulsion and more homogeneous distributed, the more sudden the decrease of times; as a result, for the same effect of reducing the nitrogen oxide generation, it will be necessary a smaller percentage of water for emulsification. For a systematical differentiation of fuels, from the three points of interest, namely, of ignition, of combustion and of luminous drop energy, the following specific indices and global quality indices of combustion have been defined:

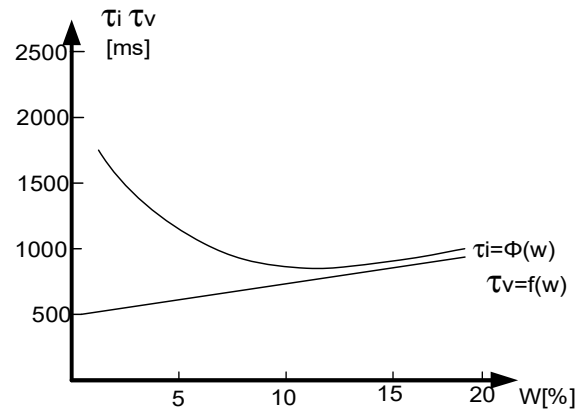

Figure 2 The influence of water content in water – RMG35 marine heavy fuel emulsion on the quantities τ_i and τ_v.

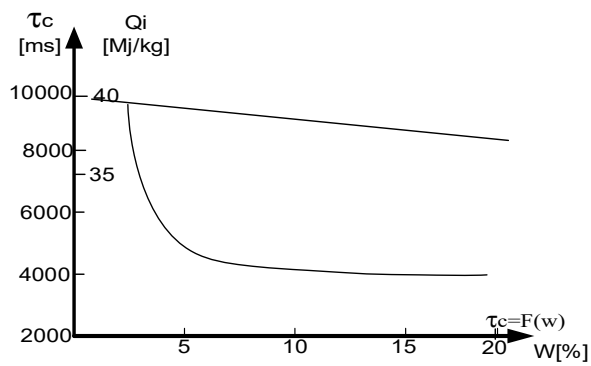

Figure 3 The influence of water content in water RMG35 marine heavy fuel emulsion on the quantities Q_i and τ_c.

- the expression of combustion quality S_a (its value is reduced according to the damage of fuel quality);

$$S_a = \frac{\tau_c}{\tau_v}. \quad (7)$$

To state the weight of ignition process to the combustion processes of volatile matters and cenosphere, the ignition ratio ψ has been defined, increasing with the rise of τ_i value:

$$\Psi = \frac{\tau_i}{\tau_i + \tau_v + \tau_c}. \quad (8)$$

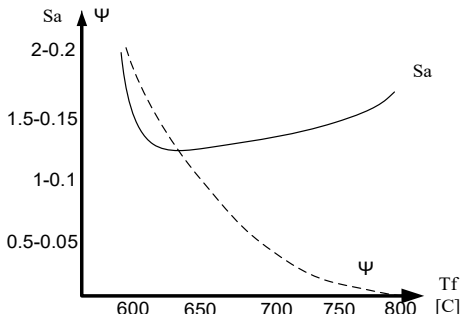

Figure 4 The variation according to the temperature of combustion simplex S_a and ignition ratio ψ.

The weight of the energy radiated by burning the volatile matters E_v to the total energy $E_v + E_c$ has been stated by the radiation index (ratio) B, of which the value decreases with the damage of fuel quality:

$$B = \frac{E_v}{E_v + E_c}. \quad (9)$$

The global combustion quality index G = f(A,0) decreases by damaging the composition of heavy liquid fuels:

$$G = C\frac{\tau_v}{\tau_i + \tau_c}. \quad (10)$$

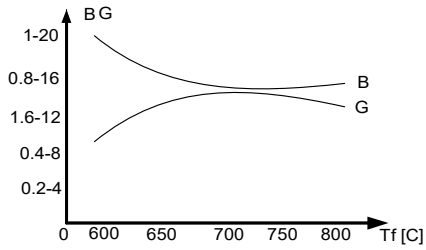

Figure 5 Variation of B and G indices depending on the temperature T_f.

3. CONCLUSIONS

The test results of the isolated water/heavy fuel emulsion droplet burning presented, lead to the following conclusions:

- the increase of S_a value together with the increase of cenosphere content of fuel;
- the decrease of ignition index ψ by increasing the temperature T_f;
- the ignition index (ratio) ψ, increases with the rise of τ_i value;
- the decrease of radiation index B, by damaging the content in cenosphere of fuel.

The introduction of water into the combustion chamber reduces the combustion temperature due to the absorption of energy for vaporization. Thus, the humidification can reduce the NO_x emissions.

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NEW IDEAS REGARDING THE GRAPHICAL REPRESENTATIONS IN COMPUTER BASED MODELING OF THE MECHANICAL ENGINEERING PHENOMENA

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ABSTRACT

Extensive use of the iconic symbolization and visual representation are effects of the nowadays internationalization conditions. In this context, visual representation of the engineering data becomes even more important as it was before because it offers the grounds for quick understanding of the phenomena under investigation in international research teams. Development of original computer based methods to process the data must take into account this actual demand regarding the graphical representation. A first idea we used to create general and flexible computer based instruments was to express analytically the data to be graphically represented. The second idea was to employ common use data formats in our interfaces in order to use the best features of the commercial applications which use such formats, i.e. CSV. Using these ideas and the according computer based solutions an analyst may employ a wide range of advanced software instruments in order to develop creative and intelligent solutions in engineering.

Keywords: *original computer based instruments, data graphical representation, data analytical definition.*

1. INTRODUCTION

Analytical models, numerical models and experimental studies are employed to model complex phenomena in engineering. Relevant and accurate results may be acquired, usually by using original computer based models which may be used in interdisciplinary or in hybrid models.

Scientific research in engineering requires the transition between the basic levels of the hierarchy of knowledge[1] that usually means to process large amount of data and to draw conclusions.

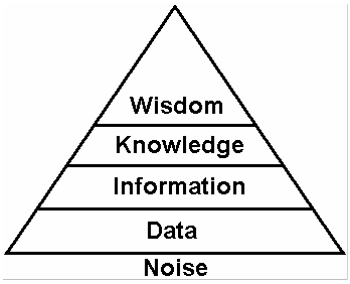

Figure 1 – Hierarchy of knowledge

All the previously mentioned models use graphical interpretation of the results because images offer a higher degree of relevancy. In this way, visual information synthesizes the numerical results and lead to a meta-level of understanding of the phenomenon.

Creation of original software instruments used to graphically express information in engineering is a long run concern of the authors, [1], [5].

In the following sections are presented some of the original solutions regarding the graphical representation of the data conceived in the past 5 years.

2. BASIC PRINCIPLES

The decision to develop original software applications which, beside the numerical data offer graphical information is based on a series of criteria that, because of their generality, may be considered principles.

Repetitive problems require computer based solvers in order to have fast and accurate results. Moreover, a complex research problem may be analyzed in terms of a work breakdown structure[2], in this way being identified the repetitive problems and the modules which require the development of original computer based instruments.

A thorough analysis of the problem to be solved must identify the problems that require *original solutions* and not to re-invent solutions which are already implemented.

Keep the solution as simple as possible is another idea to be followed when an original software instrument is created. There must be noticed that over parameterizing an implementation may lead to complex solutions which require more care during the maintenance.

The implementation must define libraries which include *reusable original code*. In this way a new application may be easily implemented using libraries and including the functions or methods already implemented and tested.

Another idea is to search for solutions which may *interface existing applications* which offer graphical facilities or data processing libraries of functions. In this way the new application may be rapidly implemented and it may take advantage of the strengths of the existing (commercial) software. The applications which are used must be either cross-platform, or there may be found similar software running on other platforms.

[1] https://en.wikipedia.org/wiki/DIKW_Pyramid, accessed on May 8th, 2016

[2] https://en.wikipedia.org/wiki/Work_breakdown_structure, accessed on May 8th, 2016

The original applications to be developed must use the *latest information technologies*. However, if a program uses an obsolete technology there may be found libraries which make the upgrade more facile[3], [1].

3. INTERFACES BASED ON COMMA-SEPARATED VALUES FILES

"Comma-Separated-Values"[4] is a generic designation of this format type. A feature least known of the CSV files is the fact that the character used as a fields' separator may be customized. For instance, if the first line of the CSV file is "**sep=;**", this means that the fields' separator is ";" and the decimal point may be either ".", or ",". If the first line is "**sep=,**", this means that the fields separator is "," and the decimal point must be ".".

The use of the comma-separated values format, CSV, has several strengths:

- It can be used by all the spreadsheet cross-platform applications;
- The CSV files may be modified using a simple text editor;
- Many software applications in engineering use the CSV format for the data input and output;
- The according spreadsheet applications may be used to visualize the imported data using a wide range of charts or to perform various calculi.

For instance, the parameters of a sketch in NX may be edited using **Tools → Expressions** and then using the 'Spreadsheet Edit' icon, figure 2.

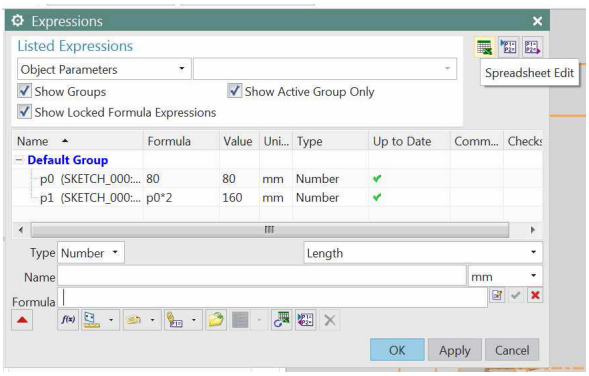

Figure 2 – CSV input and output files

Then, the parameters may be either modified, or imported from an external CSV file, that, for instance, was previously created by a dimensioning software. It results that the development of parameterized designs is an optimal way to reuse them in a new context, with new dimensions generated on the basics of the new design requirements, i.e. the new running conditions.

Using **Add-In → Update Expr** the values are updated, figure 3. When the Excel application is closed, the sketch inside NX is updated.

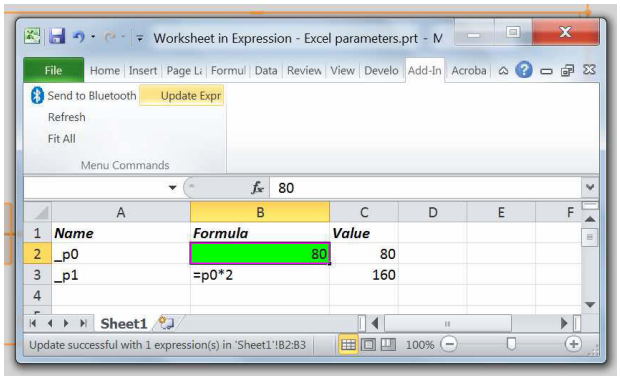

Figure 3 – Update of the NX parameters stored in an Excel table

The CSV files used in Excel may be also used to input new data in Femap/Nastran using the API facilities.

There must be noticed that, so far, we identified two major directions in which the API facilities combined with the CSV files may be used:

- The first one regards the import of the geometry, of the loads and of the locked degrees of freedom (model of the supports) of a structure, [12], see figure 4.
- The second one regards the definition of the cross sections' shapes using the coordinates of the points stored in CSV files, [11], figure 5.

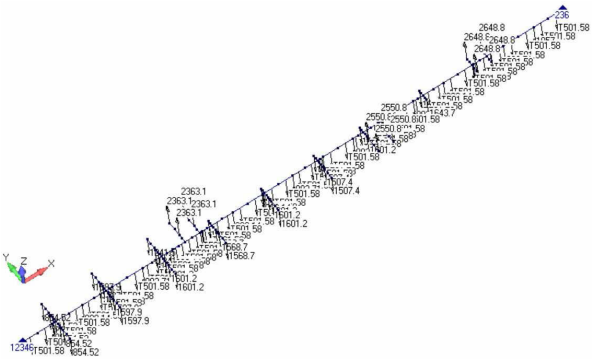

Figure 4 – FEM model automatically generated in Femap/Nastran using the API facilities and the CSV input files

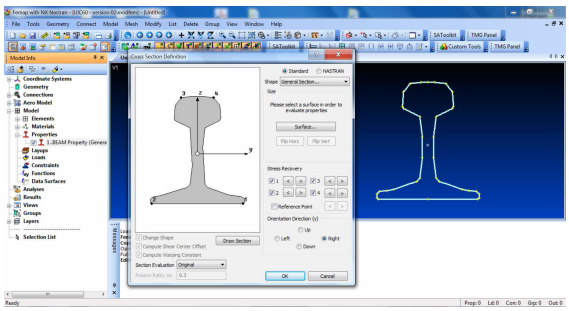

Figure 5 – Cross section automatically generated in Femap/Nastran using the API facilities and the CSV input files

[3] http://math.ubbcluj.ro/~sberinde/wingraph/, accessed on May 8th, 2016

[4] https://en.wikipedia.org/wiki/Comma-separated_values, accessed on May 8th, 2016

Other software project where CSV files were used is presented in [8]. A curve is defined by a set of points whose coordinates are given in a CSV file, [8], figure 6.

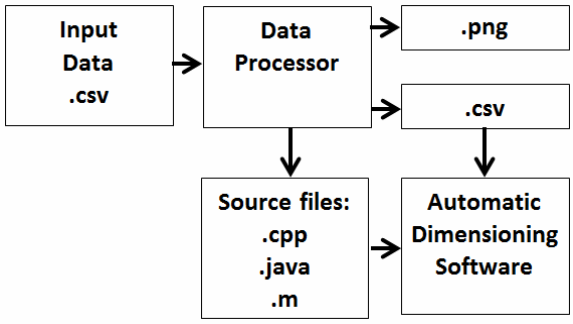

Figure 6 – CSV input and output files

The data processor uses the input CSV file in order to approximate the curve using spline functions. The output analytic information offered by this application is:

- Identifier of the current interval;
- Abscissa of the leftmost point which defines the current interval;
- Abscissa of the rightmost point which defines the current interval;
- Coefficient of the third degree term of the spline function along the current interval;
- Coefficient of the second degree term of the spline function along the current interval;
- Coefficient of the first degree term of the spline function along the current interval;
- Coefficient of the free term in the current interval.

This set of output data is expressed in various ways, such as:

- A PNG image file which presents the initial points, the linear approximation and the spline approximation;
- A CSV file which stores a set of the previously mentioned parameters of a given spline function on the according line;
- Source code automatically developed by the processor; there were considered the "m" programming language used by GNU Octave and MATHLAB, the "cpp" files specific to the C++ programming language and the "java" files.

In this way the data processor may be easily linked to the upper-level applications which may use the curves analytically expressed as spline functions.

The must be noticed that the spline functions expressed analytically and automatically implemented may be used in various case studied, not directly related to interpolation problems, but also in integration operations where the form of the spline functions is very simple and, therefore, very useful for applications. In this way, paper [9] presents a general analytical method used to compute the geometrical characteristics of the cross sections whose boundaries are defined as sets of spline functions. The integrals to be computed are generally defined, the analyst being asked to solve just one general integral instead of the specific integrals defined for A, S_Y, S_Z, I_Y, I_Z and I_{YZ}.

This computer based interpolation method may be used for various types of models. Figure 7, [10], presents the graphical results of an application in the automatic experimental data processing in photoelasticimetry. As it can be noticed, the isocline curves expressed in an analytical way using the spline functions (the curves that don't 'hold water') are employed to compute the spline functions which approximate the isostatic curves, i.e. the trajectories of the principal stresses and strains.

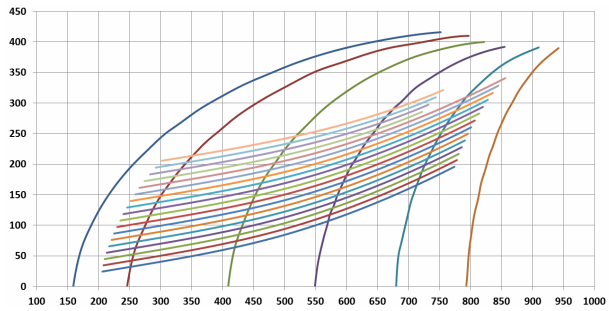

Figure 7 – Results of the automatic experimental data processing in photoelasticimetry

However, if the coefficients of the third and of the second degree terms in the current spline function are zero, we have a classic linear interpolation of the curve. If we consider only the linear interpolation, a calculus domain may be discretized in convex polygons, being used specific computing methods of the geometrical characteristics, [11].

4. CONCLUSIONS

One can notice that one of the actual trends is to extensively use iconic symbolization and visual information, [3], [4]. In this context, the graphical representation of the data in engineering offers synthesized information that may be easily analyzed. The graphical representation resulted from the analytical definition of the data is a more profound approach which offers connectivity between the analytical, numerical and experimental studies of a hybrid complex model.

In this context, the CSV files are an appropriate interface between the various original software applications developed in various programming languages under various operating systems.

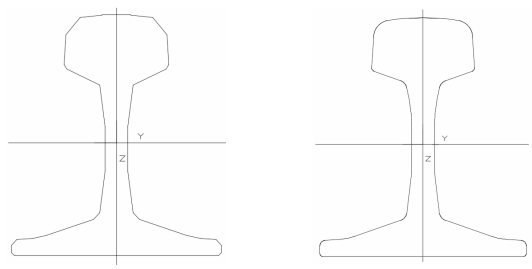

Figure 8 – Cross section automatically generated in AutoCAD using script files

However, each CAD application may have specific facilities useful for automatic data representation, i.e. automatic design, [11], figure 8.

5. ACKNOWLEDGMENTS

Ideas regarding the computer aided studies to be integrated in hybrid or cross-domain models are the results of the studies developed in the framework of the MIEC2010 bilateral Ro-Md research project, “Mathematical Models for Inter-Domain Approaches with Applications in Engineering and Economy”, [7], under the supervision of the National Authority for Scientific Research (ANCS), Romania, which is the follow-up of the ID1223 scientific research project: "Computer Aided Advanced Studies in Applied Elasticity from an Interdisciplinary Perspective", 2007-2010, [2], under the supervision of the National University Research Council (CNCSIS), Romania.

Ideas regarding the computer aided analytical models in structural problems are partial results of the computer based model developed in the scientific research study ‘Development of computer assisted marine structures’, which is a component of the RoNoMar project, [6], 2012.

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LOAD CASES SCENARIOS USING A FINITE ELEMENT MODEL OF A ROTATING HALF BRIDGE BELONGING TO A SETTLING TANK

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ABSTRACT

Accuracy of the studies based on the finite element method was a constant concern of the authors. Along the time, there were conceived methods to calibrate the numerical models and methods to verify the precision of their results, the basic principle being "check, double check and over check". Once the accuracy of a finite element model is confirmed, we may use it for additional studies, such as: weight optimization, structure placed on deflected supports, structure manufactured from other materials etc. This experience earned over the time was used in the structural analysis of a half-bridge belonging to a settling tank in running conditions. The problem is complex, therefore the details should be kept under a tight control and once we have more precise information regarding some of the input data, a new more accurate model should be generated. Starting from this idea there were created input data generators. The results were stored in CSV files. These CSV files are used as input data for the analytical model of the structure implemented as a C++ computer code, as well as for the finite element model. The creation of the finite element model employed the API facilities specific to Siemens' Femap/Nastran commercial application. The API facilities being a valuable instrument for the quick creation of a new finite element model, there may be modified the CSV input files where the loads are stored, in order to define several load case scenarios. For instance, we considered scenarios where the floating barrels are broken, therefore the according forces in the CSV file are considered to be zero in the points where the buoyancy forces existed. Finally we considered other scenario where all the barrels are broken, the structure being additionally loaded by the weight of an operator who is inspecting the equipment. Using our original computer based instrument - the API finite element model generator - there may be considered various load cases. The paper is an initial study of the load cases starting from the CSV files, being presented the results of the according finite element models. A more thorough follow-up study will start from the C++ data generators and will assess what broken barrels have the greatest influence onto the stresses. This paper may be considered interesting not only for the particular results presented, but mainly for the research strategy which allows this kind of approaches where the hard work is done by the computer, the researcher being focused on the creative aspects of the mechanical engineering structural analysis.

Keywords: *load case scenarios, finite element model, input data processor, comparison.*

1. INTRODUCTION

This structural problem is complex because the geometry of the half-bridge is complicated, the loads must be meticulously modeled and the behavior of the supports must be carefully analyzed. The half-bridge must sweep the sludge from the inclined floor of the settling tank and send it in an external tank.

2. MAIN BRIDGE CONFIGURATION

The half-bridge has several components:

- scrapping blades used to vacuum the sludge;
- vertical and inclined pipes which connect the scrapping blades to the collecting local tanks;
- floating barrels tied to the collecting local tanks;
- horizontal submerged pipes from the collecting local tanks to the collecting central tank used to discharge the sludge; next to the collecting central tank, each pipe has a sort of 'drain trap' used to start the sludge suction process;
- walkway for the operators who must inspect, maintain or repair the equipment;
- central turbine for the inlet sludge-water mixture;
- the main beam having a tubular section which supports the previous components.

The inner end of the main beam is supported in the center of the circular clarifier. The half-bridge rotates around the vertical axle spindle which supports the main beam in this point. At the outer end, the half-bridge is supported on a wheel which is rotated by an electric motor and a reduction gearbox. The half-bridge performs a full revolution along the tank's edge in 57 minutes.

Figure 1 – Rotating half-bridge in an empty tank

To have a clear geometric model of the calculus domain, the half-bridge was designed in Siemens' NX, Figure 2. The level of detail was high, the resulting drawing being an accurate representation of the real structure. However, for the finite element analysis a simpler model was necessary because the automatic meshing generated too small solid finite elements.

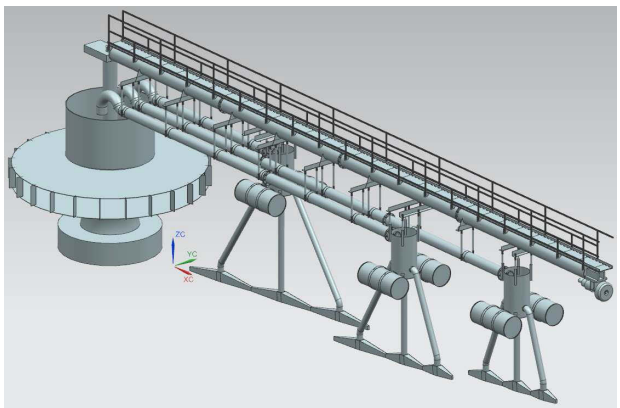


Figure 2 – NX CAD model of the half-bridge

There must be noticed that the modelling of the calculus domain and of the loads require special attention. A general analysis of the forces acting on the structure is presented in [4].

3. INPUT DATA GENERATION

The early finite models which used solid elements failed because the size of the elements was too small, the according number of nodes and unknowns being very large. Later, a less detailed geometry led to models which could be solved in Femap/Nastran.

Apart of these attempts, we developed finite elements models using beam type elements. The first models took into consideration the main beam having a tubular shape together with the brackets positioned aside it, which may be considered local cantilevers. However, because the dimensions of the two classes of beams were significantly different, the model could not be validated.

The newly problem we had to solve was to decide if we consider a general strength problem, or a local strength problem that requires both types of beams. Finally, we decided that the appropriate study of the equipment requires a general strength approach.

To have an accurate model of the loads all the details should be taken into account. Being a lot of calculi to perform, original input data generators were developed. All the basic input information was parameterized, in this way being generated more accurate models, once we have more precise basic information or once we identified more precise hypotheses.

The results of the data generation process consist of CSV files where the geometric information is stored (points and lines) and where the loads are stored (forces in points and distributed forces along lines/curves).

These CSV files are used as input data for both, the analytic model implemented as a C++ code and for the development of the finite element model in Femap/Nastran, the data being loaded using the API facilities.

The basic reference was the geometry of the structure under investigation, i.e. points and lines/curves, not discretization related notions, such as nodes and elements. Moreover, forces are located in points and the equally distributed forces are located along the lines, thus the loads also use the geometry, not the discretization of the structure. In this way we have minimum modifications to operate when we generate a discretization, we test it and then we discard it if a higher accuracy is needed, therefore a new discretization must be done.

4. LOAD CASE SCENARIOS

Once we have an accurate finite element model and a software instrument for the automatic data input, i.e. the original program which employs the API facilities of Femap/Nastran, we are able to imagine various load case scenarios in order to test the behavior of the structure.

In this way we consider the loads generated by the C++ original code. In the according CSV files we have equally distributed forces along each 'curve' of the structure's geometry and forces in the points of the structure.

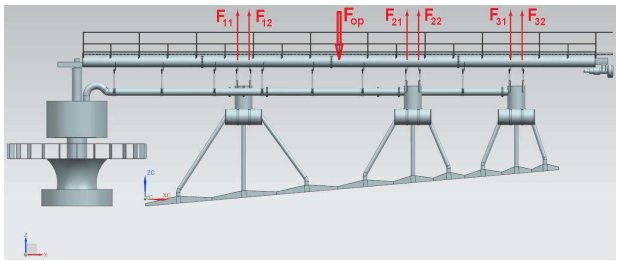


Figure 3 – Buoyancy forces produced by the floating barrels applied in the supports of the local tanks and the weight of the operator

The above figure presents the F_{ij} forces applied on the structure which take into account the buoyancy forces produced by the floating barrels. The buoyancy forces are important because they act as local supports, otherwise the main beam is supported only by its ends. The F_{ij} forces are the only forces along the beam directed upwards, while all the other forces are directed downwards, being weighting forces. In these regions, the forces applied on the structure consist of the weighting force of the local tank and the buoyancy forces directed in an opposite direction.

We consider the following forces: F_{11} and F_{12} for the inner set of barrels, F_{21} and F_{22} for the central set of barrels and F_{31}, F_{32} for the outer set of barrels. There is also presented the weight of the operator, F_{op}.

If the floating barrels are broken, it results that the F_{ij} forces are zero. If an operator is on the walkway, its weight is an additional load applied on the structure.

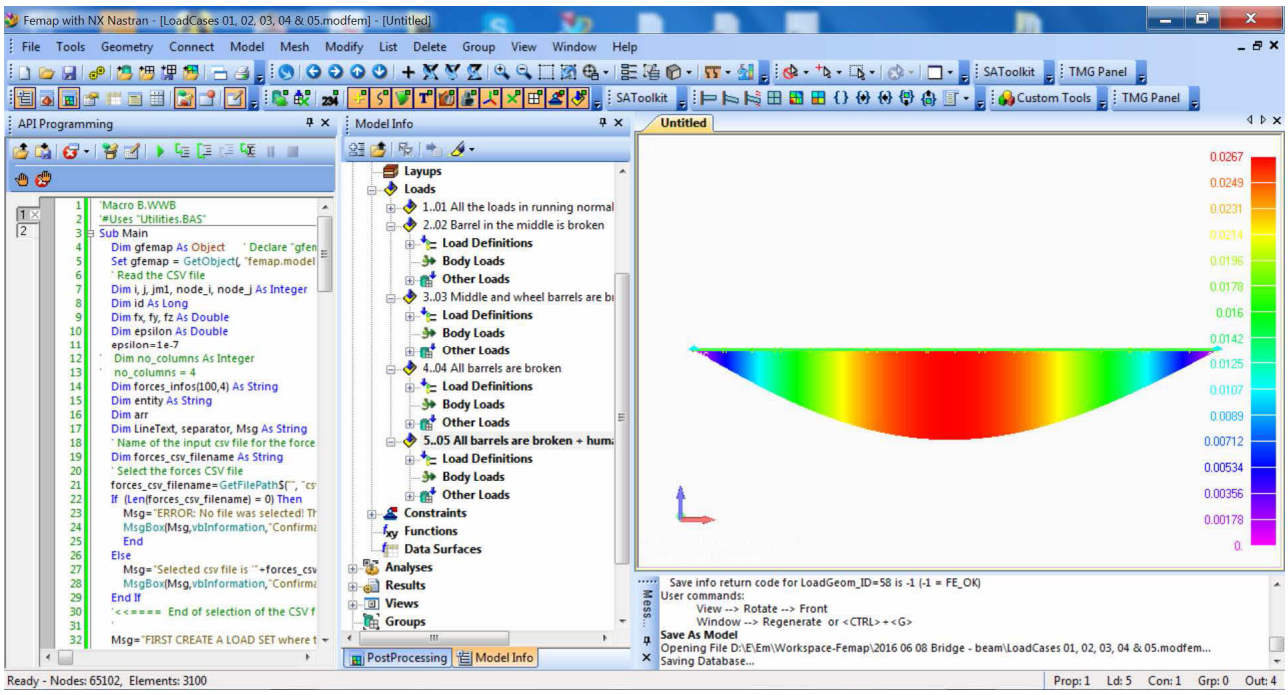


Figure 4 – Data loading using the API facility and the load case scenarios

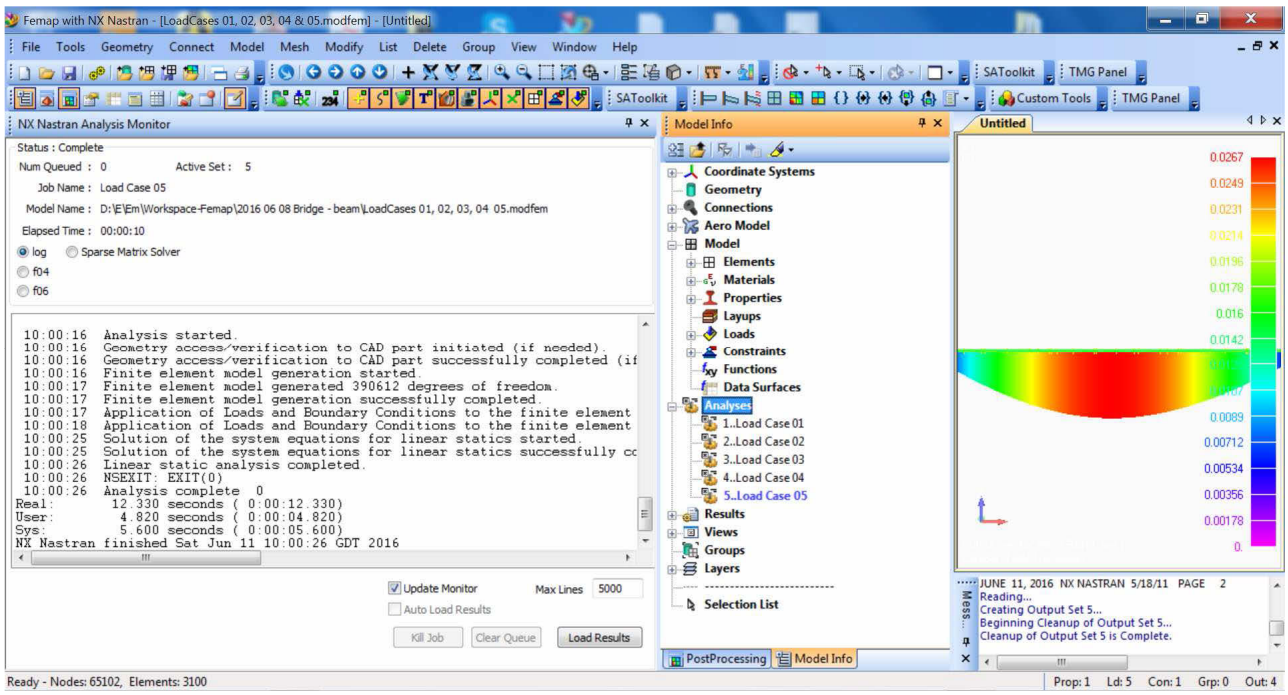


Figure 5 – End of the analysis no. 5 for the 5th load case scenario

Let us consider the following load case scenarios:

1. running normal conditions, $F_{op} = 0$;
2. $F_{21} = F_{22} = 0$; $F_{op} = 0$;
3. $F_{11} = F_{12} = 0$; $F_{31} = F_{32} = 0$; $F_{op} = 0$;
4. $F_{11} = F_{12} = 0$; $F_{21} = F_{22} = 0$; $F_{31} = F_{32} = 0$; $F_{op} = 0$;
5. $F_{11} = F_{12} = 0$; $F_{21} = F_{22} = 0$; $F_{31} = F_{32} = 0$; $F_{op} \neq 0$.

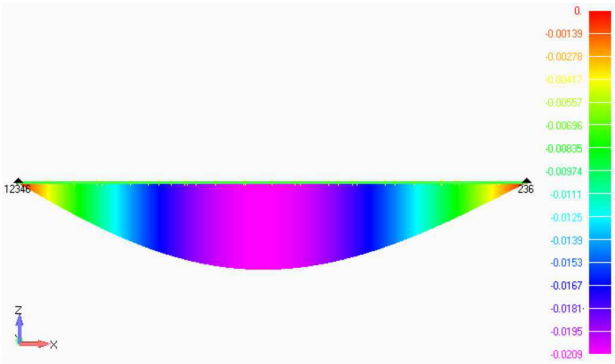
As it can be noticed, the floating barrels start to break from the central group of barrels, next the outer set of barrels, then the inner set of barrels and finally an operator is placed on the walkway.

For each scenario there was loaded the according CSV file in which the force which takes into account the buoyancy forces is zero, figure 4. For each load case the structure was analyzed, an according output set of data being generated, figure 5.

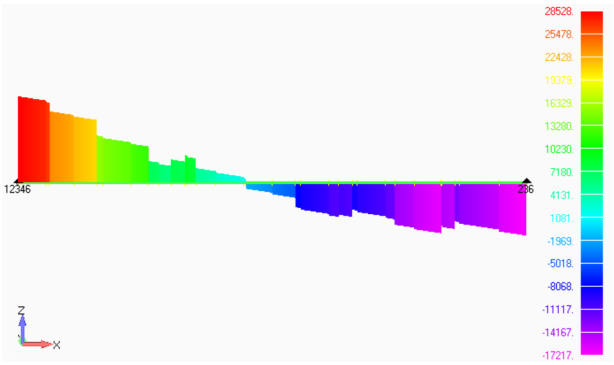
Finally we had 5 output data sets, the most important being the scenarios no. 1 and no. 5.

5. COMPARISON BETWEEN THE RESULTS

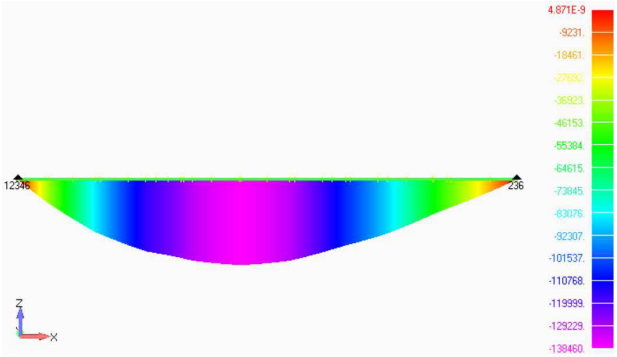
Scenario no. 1 presents the running normal conditions. The according free body diagrams are presented in the following figure.



a) Scenario 1 – Displacement of the half-bridge



b) Scenario 1 – Shear force diagram



c) Scenario 1 – Bending moment diagram

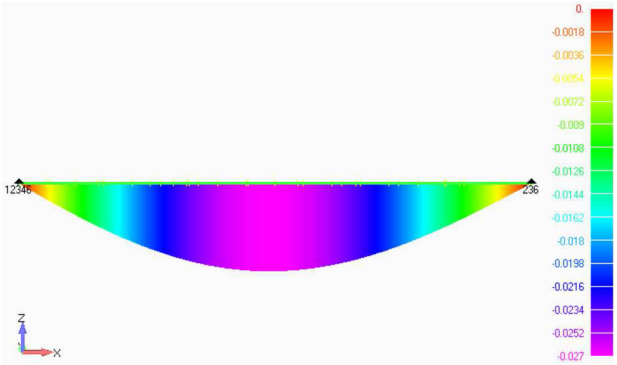
Figure 6 – Scenario 1: displacements, shear force diagram and bending moment diagram

Scenario no. 5 has the largest forces applied on the structure. The according free body diagrams are presented in figure 7.

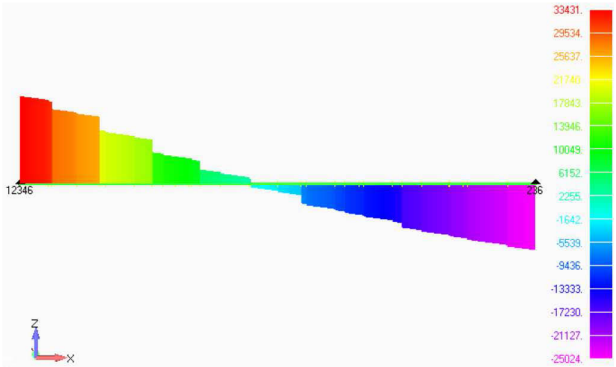
By analyzing both figures, 6 and 7, one can notice the correlation between the shear force diagrams and the according bending moment variation:

- along the intervals where the shear force is positive, the bending moment is increasing, while along the intervals where the shear force is negative the bending moment is decreasing;
- in the section where the shear force is zero, the bending moment has an extreme value.

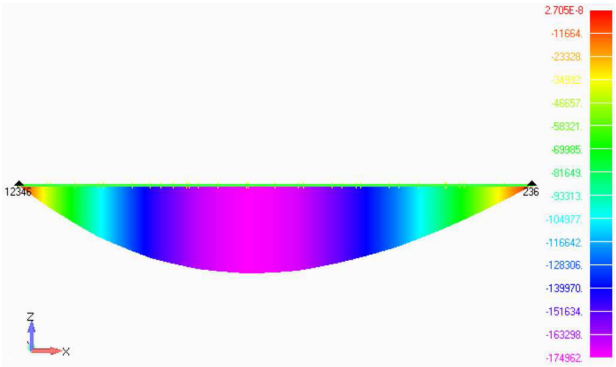
In both shear force diagrams one can notice the same decreasing trend with the same slope, which is produced by the equally distributed force.



a) Scenario 5 – Displacement of the half-bridge



b) Scenario 5 – Shear force diagram

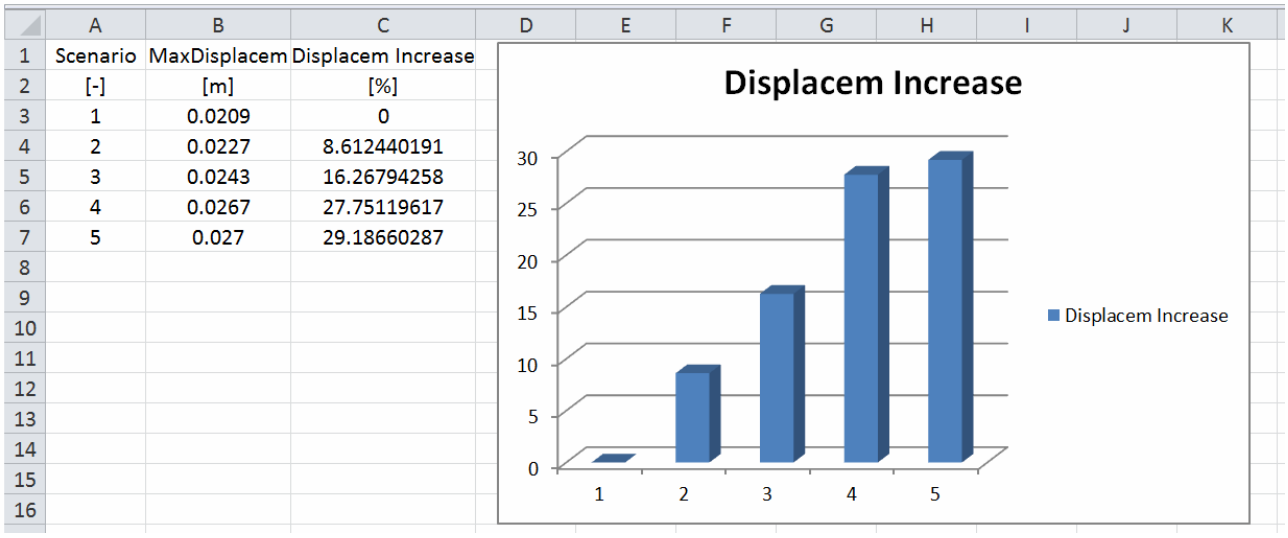


c) Scenario 5 – Bending moment diagram

Figure 7 – Scenario 5: displacements, shear force diagram and bending moment diagram

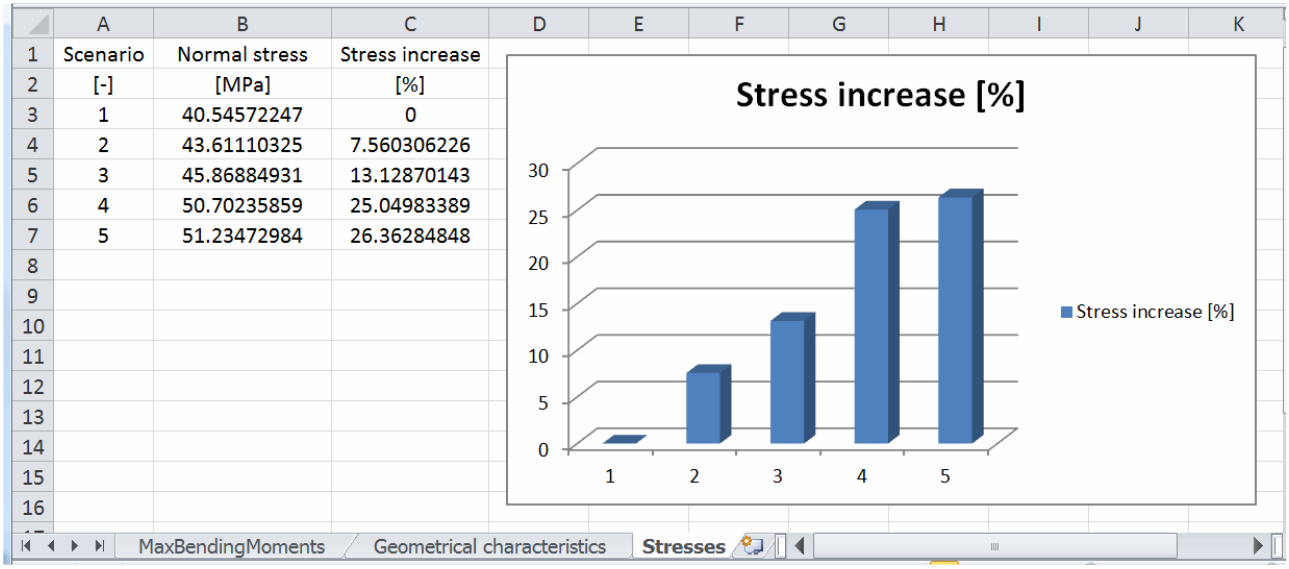
We remind that the weight of the main beam was modeled as an equally distributed force.

Comparing the shear force diagrams of scenarios 1 and 5, one can notice that in scenario 1 the decreasing trend is interrupted by a sudden variation towards the positive range of values produced by the effect of the buoyancy forces. Moreover, comparing the values at the ends of the diagrams, i.e. the reactions, we notice the lower values when the buoyancy forces are applied.



Scenario	MaxDisplacem	Displacem Increase
[-]	[m]	[%]
1	0.0209	0
2	0.0227	8.612440191
3	0.0243	16.26794258
4	0.0267	27.75119617
5	0.027	29.18660287

Figure 8 – Increase of the maximum displacement for each load case scenario



Scenario	Normal stress	Stress increase
[-]	[MPa]	[%]
1	40.54572247	0
2	43.61110325	7.560306226
3	45.86884931	13.12870143
4	50.70235859	25.04983389
5	51.23472984	26.36284848

Figure 9 – Increase of the normal stress for each load case scenario

The quantification of the effects of the buoyancy forces are given in figures 8 and 9. All the values were also evaluated in percentages, with respect to the values in scenario no. 1 (running normal conditions).

Regarding the maximum deflection, its increase is about 29% in scenario no. 5, figure 8. There may be also noticed the increments between the load case scenarios of: 8.6%, 7.6%, 11.5% and 1.4%. It results that the presence of an operator on the walkway is not that important as we have initially evaluated. In absolute values the deflections aren't very large, therefore the structure isn't very slender.

The maximum values of the bending moment were used to compute the stresses. According to figure 9, the normal stress was increased by 26% in scenario 5, in comparison with the first scenario. The increments of the maximum bending moment are: 7.6%, 5.6%, 11.9% and 1.3%. In absolute values the stresses are not very large. Along the time materials' fatigue may occur, but the next technological cycle which will probably replace this equipment may occur even faster, before the structure fails due to fatigue.

By comparing the increments, one can notice that the largest one is given by the 4th scenario when the effect of the last group of floating barrels is disregarded (barrels next to the center are broken) and the smallest is produced by the assumption that an operator is located on the walkway.

6. CONCLUSIONS

This type of study structured in load case scenarios offers two types of information. The first class of information regards the deflections of the structure, i.e. if the scrapping blades will press against the tank's floor if the floating barrels are broken. The second aspect is given by the strength of the structure, evaluated under the same hypotheses.

The limits of the study are given by the fact that the forces acting in the points where the buoyancy loads are applied are considered to be zero, the according values

being set in the appropriate CSV files. A more thorough study will use the C++ input data generator which will offer more accurate values of the loads in these points. In the following study it will be also evaluated the effect of each group of 'broken' barrels. The according scenarios envisioned so far are:

1. running normal conditions, $F_{op} = 0$;
2. $F_{11} = F_{12} = 0$; $F_{op} = 0$;
3. $F_{21} = F_{22} = 0$; $F_{op} = 0$;
4. $F_{31} = F_{32} = 0$; $F_{op} = 0$;
5. $F_{11} = F_{12} = 0$; $F_{21} = F_{22} = 0$; $F_{31} = F_{32} = 0$; $F_{op} \neq 0$.

However, the behavior of the structure may be assessed using the load cases previously considered.

There must be also noticed the research strategy, i.e. the high importance of the original software instruments which use the computer for the complex and time consuming calculi, the structural analyst having the opportunity to be focused on the creative aspects of the study.

7. ACKNOWLEDGMENTS

Models based on the strength of materials theory were studied in the framework of the MIEC2010 bilateral Ro-Md research project, "Mathematical Models for Inter-Domain Approaches with Applications in Engineering and Economy", [3], under the supervision of the National Authority for Scientific Research (ANCS), Romania, that is the follow-up of the ID1223 scientific research project: "Computer Aided Advanced Studies in Applied Elasticity from an Interdisciplinary Perspective", 2007-2010, [1], under the supervision of the National University Research Council (CNCSIS), Romania.

Analytical models and the automatic calculus in structural studies were also studied in the scientific research project 'Development of computer assisted marine structures', which is a component of the RoNoMar project, [2], 2010.

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STUDIES REGARDING THE IMPACT OF 10 METERS LONG, 26'' PIPE ON A REINFORCED PIPE LAYER DECK

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ABSTRACT

Usually, the work deck of a pipe layer is designed by considering the load forces encountered in normal conditions. Sometimes, during loading operations, pipes falls and hits the deck. In this paperwork is studied the structural response of a pipe layer deck during such an accident.

For the study it was considered a 10000mmx 660mmx17.5mm pipe falling from heights from 1 to 2 m.

Keywords: *Structural response, pipe layer, dynamic analysis.*

1. SCOPE OF THE STUDY

The purpose of this paperwork is to study the structural response of a pipe layer deck when a 26'' pipe falls from heights between 1 and 2 meters.

The study was carried out using Ansys 12.1 software.

2. GEOMETRY

For the study it was considered the following geometry:

- Deck

The deck consists in a 20mx10m steel plate having 5cm thickness. The plate is reinforced with 10cm wide and 15 cm in depth transversal reinforcements. The distance between reinforcements is 2.4875m.

The deck geometry is presented in following figure:

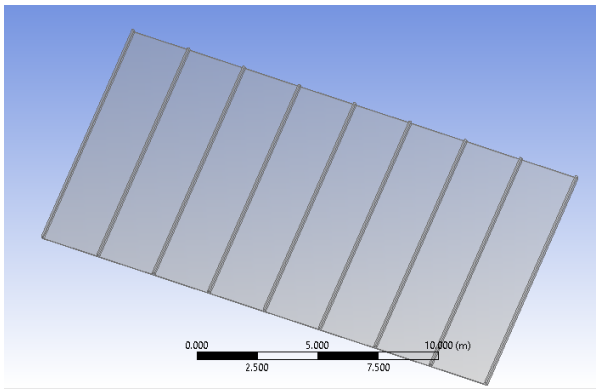

Figure 1 The deck geometry

- The pipe

The falling pipe is a 10 meters long with a 660.4 mm in diameter. The thickness of the pipe wall is 17,5 mm.

In initial position, there is a distance of 0.43 meters between the deck and the center of the pipe.

The pipe and deck geometry, in initial position, is presented in Figure 2:

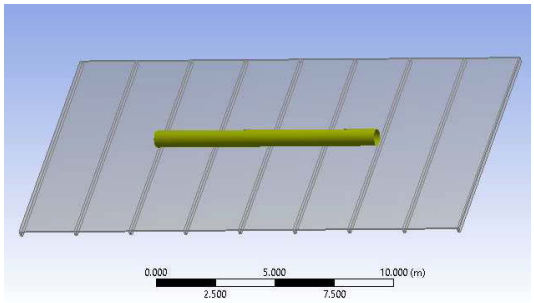

Figure 2 The pipe and deck geometry

3. MESH

For the study it was considered structured, sweep mesh.

The mesh consists in 21335 nodes and 10875 elements.

The discretization structure is presented below:

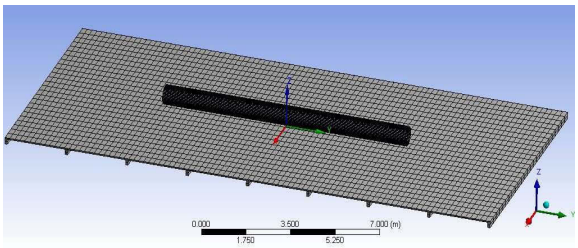

Figure 3 The mesh structure

4. SIMULATION SETTINGS AND INITIAL CONDITIONS

The deck and the pipe were considered to be made from AH36 structural steel. The properties of this steel are:

Table 1: AH36 structural steel properties

Elastic modulus	2.10E+11	N/m^2
Poisson's ratio	0.28	NA
Shear modulus	3.55E+10	N/m^2
Mass density	7700	kg/m^3

The simulation is a dynamic one. The analysis settings are presented in table 2. This table is automatically generated by the software.

Table 2: Analysis Settings

Analysis Settings Preference	
Type	Program Controlled
Step Controls	
Resume From Cycle	0
Maximum Number of Cycles	1e+07
End Time	1. s
Maximum Energy Error	0.1
Reference Energy Cycle	0
Initial Time Step	Program Controlled
Minimum Time Step	Program Controlled
Maximum Time Step	Program Controlled
Time Step Safety Factor	0.9
Characteristic Dimension	Diagonals
Automatic Mass Scaling	No
Solver Controls	
Solve Units	mm, mg, ms
Beam Solution Type	Bending
Beam Time Step Safety Factor	0.5
Hex Integration Type	Exact
Shell Sublayers	3
Shell Shear Correction Factor	0.8333
Shell BWC Warp Correction	Yes
Shell Thickness Update	Nodal
Tet Integration	Average Nodal Pressure
Shell Inertia Update	Recompute
Density Update	Program Controlled
Minimum Velocity	1.e-006 m s^-1
Maximum Velocity	1.e+010 m s^-1
Radius Cutoff	1.e-003
Minimum Strain Rate Cutoff	1.e-010
Euler Domain Controls	
Domain Size Definition	Program Controlled
Display Euler Domain	Yes
Scope	All Bodies
X, Y, Z Scale factor	1.2

For these studies, the initial and boundary conditions are:

- the plate was considered to be on fixed support, on perimeter
- the pipe is free to move without restrictions with different speed, for each case:
  - Case 1: v=4.429 m/s (falling from 1 m)
  - Case 2: v=4.851m/s (falling from 1.2 m)
  - Case 3: v=5.24 m/s (falling from 1.4 m)
  - Case 4: v=5.602 m/s (falling from 1.6 m)
  - Case 5: v=5.942 m/s (falling from 1.8 m)
  - Case 6: v=6.263 m/s (falling from 2 m)
- the gravity effect it is taken into account

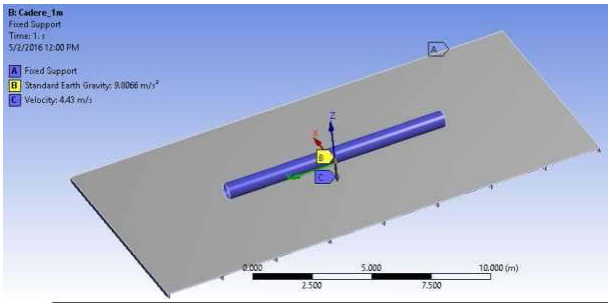

Figure 4 Initial and boundary conditions

5. RESULTS:

The results of the analysis for each case are presented below:

5.1. Graphical Results For Case 1

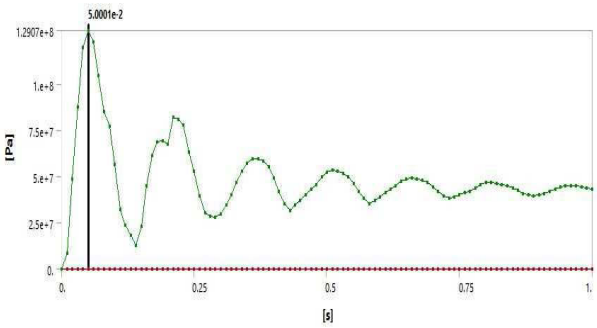

Figure 5 Maximum values of the von Misses stress

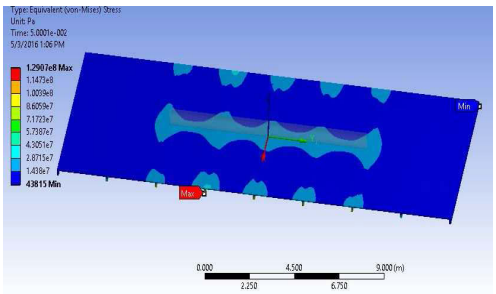

Figure 6 Von Misses stress distribution, when its maximum value is reached

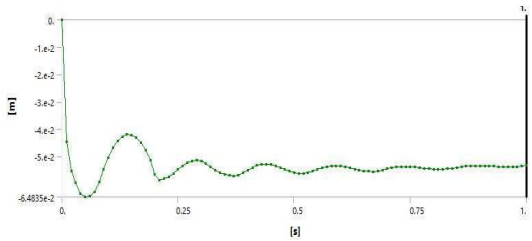

Figure 7 Pipe displacement on Oz axes

5.2. Graphical Results For Case 2

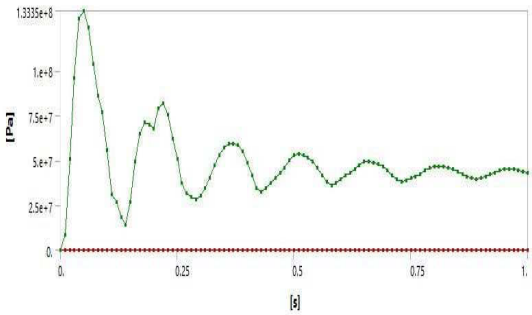

Figure 8 Maximum values of the von Misses stress

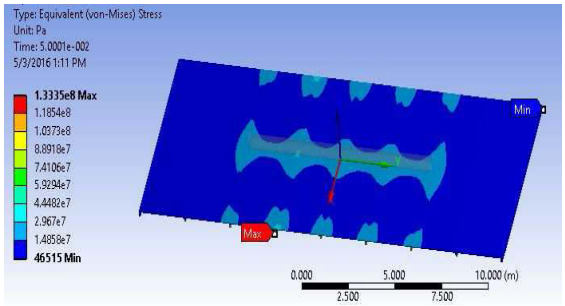

Figure 9 Von Misses stress distribution, when its maximum value is reached

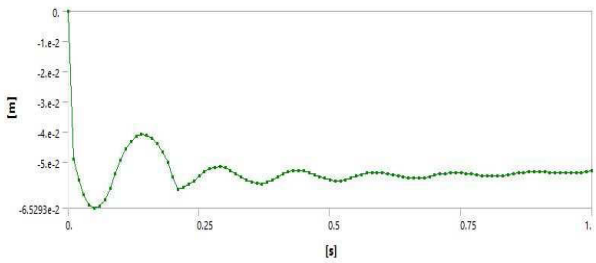

Figure 10 Pipe displacement on Oz axes

5.3. Graphical Results for Case 3

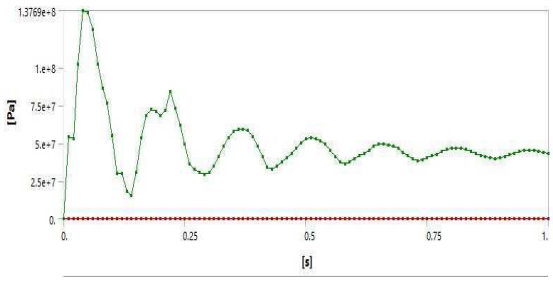

Figure 11 Maximum values of the von Misses stress

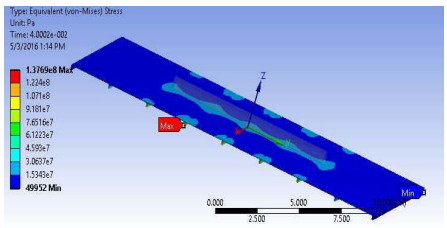

Figure 12 Von Misses stress distribution, when its maximum value is reached

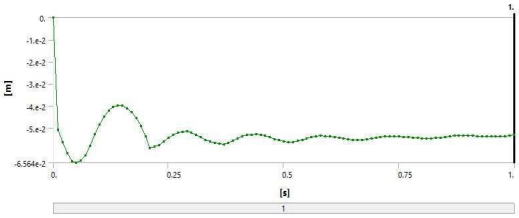

Figure 13 Pipe displacement on Oz axes

5.4. Graphical Results for Case 4

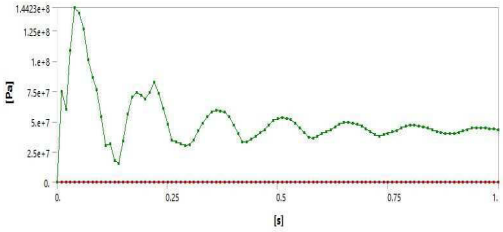

Figure 14 Maximum values of the von Misses stress

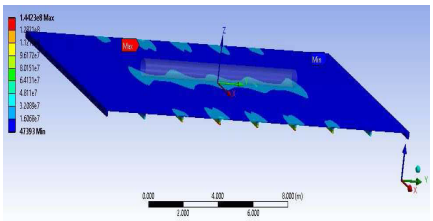

Figure 15 Von Misses stress distribution, when its maximum value is reached

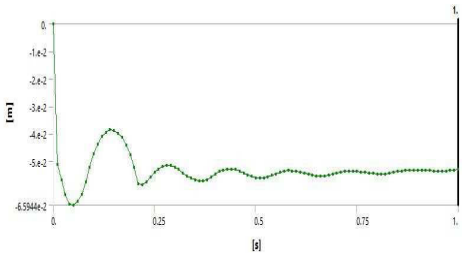

Figure 16 Pipe displacement on Oz axes

5.5. Graphical Results for Case 5

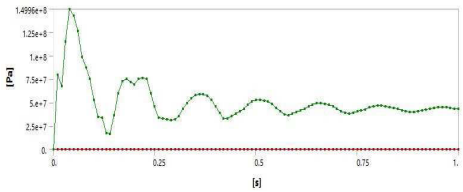

Figure 17 Maximum values of the von Misses stress

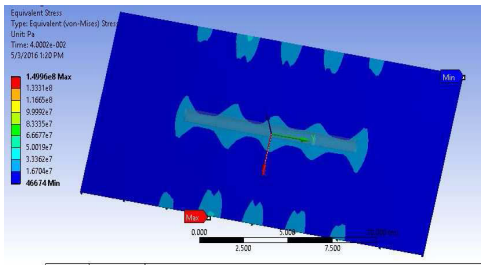

Figure 18 Von Misses stress distribution, when its maximum value is reached

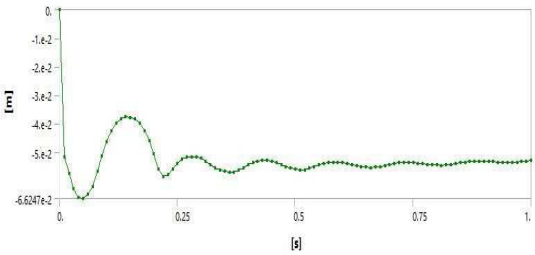

Figure 19 Pipe displacement on Oz axes

5.6. Graphical Results for Case 6

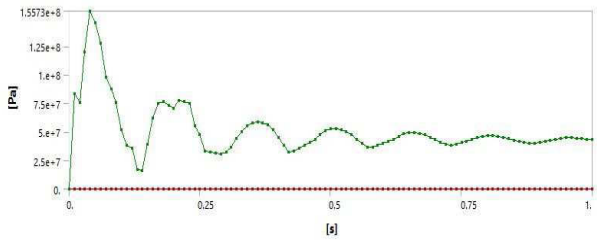

Figure 20 Maximum values of the von Misses stress

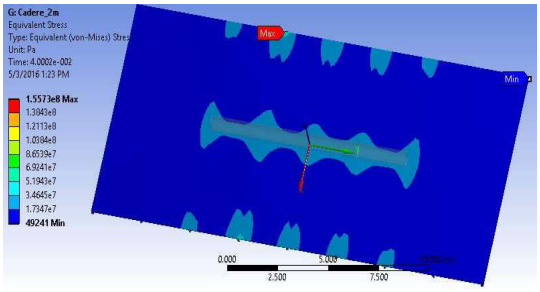

Figure 21 Von Misses stress distribution, when its maximum value is reached

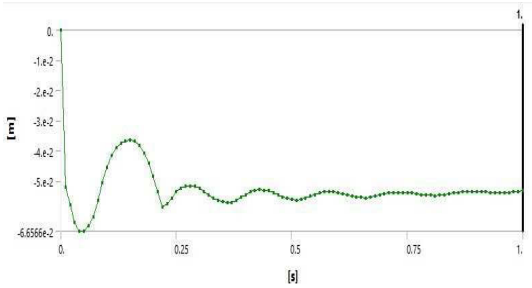

Figure 22 Pipe displacement on Oz axes

5.7. Integrated Results

The maximum values of the von Misses stress are presented below:

Table 3: Maximum von Misses values

Case	H [m]	Maximum von Mises stress [MPa]
1	1	129.07
2	1.2	133.35
3	1.4	137.69
4	1.6	144.23
5	1.8	149.96
6	2	155.73

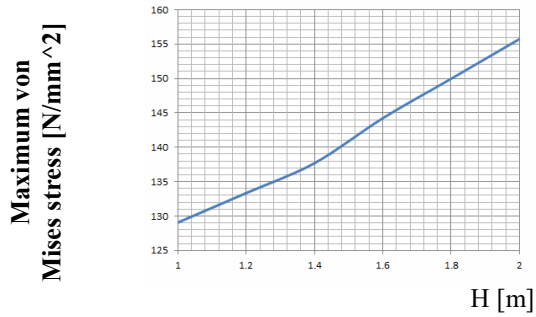

Figure 23 Maximum values of the von Misses stress for each case

6. CONCLUSIONS

In this paper is studied the effect of an accident onboard a pipe layer: a pipe falling on the deck.

Considering the graphical results of the von Misses variation, it can be seen:

1. The values of the von Misses stress in all cases stabilize around 50 [MPa]. This value represents about 14% of the elastic limit.
2. The maximum value during the impact goes from 129.07 [MPa] up to 155.73 [MPa]. This value is about 43.6% of the elastic limit.

This type of accident induces a significant stress in the deck structure and it always must be considered when designing pipe layers.

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THE THERMODYNAMIC STAND USED BY FUTURE MARINE ENGINNERS IN ORDER TO GAIN PRACTICAL SKILLS IN CMU

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ABSTRACT

This paper presents the stand used for the achieving of skills related to thermodynamic measurements, within the laboratories specific to the discipline called Thermodynamics 1, included in the curricula of the students enrolled in the Marine Electromechanics Faculty belonging to Constanta Maritime University.

Its concept allows us to ensure the measurements of temperature, flow and pressure, offering to our students the possibility to perform the scheduled works themselves. Also the stand is a useful tool used for the understanding of the phenomena taking place in the different situations thought in order to put the student face to face with several problems which might be met on board the ships.

In the paper is described the stand with its components and are provided information on the works developed for our students.

Keywords: *thermotechnics, flow, temperature ,pressure, thermodynamic stand.*

1. INTRODUCTION

Despite of the economic crises which has affected all the sectors, the need of well trained marine engineers has not decreased, being of a great importance for maritime education institutions to provide education using adequate facilities [1].

The curriculum specific for marine engineers trained in Constanta Maritime University is a successfull one because it facilitates the gain of engineering theoretical, practical and design skills leading to a self confidence on board as future professionals [2].

Thermodynamics is an important discipline for the education of future marine engineers, providing comptencies related to thermodynamic properties of systems, working conditions of cycles, evaluation of thermal and energy systems, working with tables and charts [3].

This paper presents the stand used during the course entitled Thermodynamics 1, delivered to the students enrolled in the Marine Electromechanics Faculty within CMU, this course being scheduled in their second year of study.

Our students attempt this course in the second semester and have a number of seven laboratory activities for the gaining of practical skills and a number of seven seminar activites during which they gain calculus skills, specific to this discipline.

This stand, which is presented in Figure 1, aims at presenting different types of devices for measuring temperature, pressure and flow of a fluid that traverses three types of pipes with different diameters ,each made of different materials.

Being sein this concept, it is possible to conduct the activities of laboratory specific for this discipline.

Figure1 The stand for thermodynamic measurements

As might be seen in Figure 2, which should be remake by the students, over a 6 m lenght are disposed in parallel three types of pipe: Copper, Steel and PPR.

All the pipes have 3 diffrent diameters, from 1 tol to 1/2 toli, as follows:

- Copper pipe (Cu) has dimensions 22,28 and 32 mm;
- Steel pipe (OlZn) has dimensions 1/2, 3/4 and 1 tol;
- Plastic pipe (PPR) has dimensions 20,25 and 32 mm.

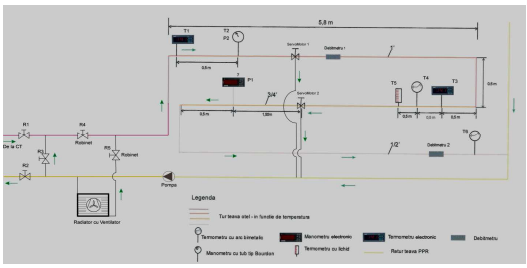

Figure 2 Schematic representation of the stand

In all three cases comes first fluid in the pipe with larger diameter, then it goes through the intermediate diameter pipe that output to cross portion with the smallest diameter.

2. DESCRIPTION OF THE EXPERIMENTAL STAND

In the scheme are present a series of valves (valves and valve actuator) that are designed to separate circuits together so we can both pressure measurements and flow rates and temperature.

The thermal agent that passes through these pipelines is hot water, prepared by a boiler powered by natural gas mural forced draft. It can heat water up to a temperature of 90^0C.

To assure the thermal agent circulation throughout the facility was mounted on the return pipe, a single-phase pump with a flow Monitors all set between 2,3 m^3/h and 1.2 m3/h.

Figure 3 Circulation pump

Because the route of the agent is not large enough, and the ambient temperature is the temperature of the laboratory, thermal agent does not have time to give away a large amount of heat and to cool long enough so we can make appropriate readings. Therefore on the return pipe ,after the pump it was fitted a battery cooling fan with aluminum wings in order to decrease the temperature of the agent. The fan flow is 400 m^3/h.

Figure 4 Cooling fan with aluminium wings

To illustrate different modes of reading and recording data (temperature, pressure and flow) were installed a series of measuring devices.

a. Bimetallic thermometer spring

Are tools that detects variation in temperature by measuring the dilation of a bimetallic coils at the end of which there is a pointer. Precision class 0-100^0C. Besides their regular use in heating, may be used in all industrial applications where the official regulations prohibit the use of mercury.

Figure 5 Bimetallic thermometer spring

b. Liquid thermometer

- scale lenght 110, 150, 200mm;
- domeins -30..+50 dgr C, 0..60 dgr C, 0..120 dgr C, 0..160 dgr C,
- housing and brass probe,
- probe lenght 40, 63,100, 160mm,
- positioning scale: streight, at 90 dgr or at 135 dgr.

Figure 6 Liquid thermometer

c. Electronic thermometer

- temperature field NTC: -40 - +110 grade Celsius;
- temperature field PTC: -50 - +150 grade Celsius;
- diferential: 0,1 - 25 grade Celsius;
- 2 inputs probe NTC sau PTC;
- 1 intrare digitala;

Figure 7 Electronic thermometer

d. Bourdon tube manometer type

The elastic element can be a Bourdon tube (single, double curved, spiral, spiral etc.), membrane capsule or bellows. Bourdon type elastic tubes are made of metal, with thin or thick walls in the shape of an arc of a circle with a central angle of 180 degrees or 270 ÷ U-shaped. Beeing relatively simple in terms of construction, these devices are widely used for measuring the pressure in the range of 1 ... 400 bar. They are used for measuring thin-walled version of low pressure (from a few millimeters of mercury and up to 10 bar), more than these values using thick-walled version. For higher pressures in the tube is using a U-shaped steel. The vortex tube has one end open and the other closed fixed and mobile, being able to move freely under the force of pressure. Through the open end of the tube pressure force acting on the inside, resulting in a deformation of the free end of the tube diameter on the upside in the case of overpressure in the sense to decrease the diameter of the tube if a negative pressure. [4]

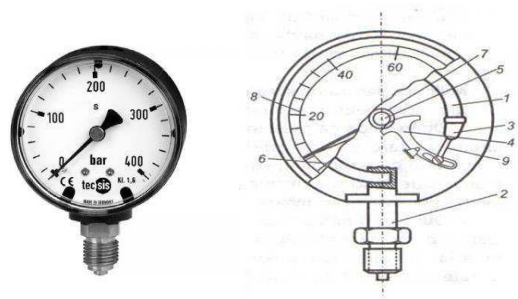

Figure 8 Bourdon tube manometer type

e. Ball valves

The role of these valves is to lock or unlock a circuit. There are on the market a varied number of models and sizes, depending on the types of fittings and needs. They are manufactured in a wide range from DN 20 up to DN 500, in different shapes and models depending of place of mounting and operation. [5]

Figure 9 Plastic ball-valve

3. DESCRIPTION OF THE PRACTICAL WORKS

Practical work that will take place in the laboratory of thermodynamics on this stand will include determining the temperature of the circulating through various types of pipes and temperature changes in different scales; measurement of flow, pressure measurements and determine the amount of heat transferred in certain conditions of temperature and pressure through pipes that make up the experimental stand. To determine the amount of heat from the working fluid, the students will use the following formula:

$$Q = \rho \times C_p \times \Delta t \; ; \qquad (1)$$

where,

Q- represents the total amount of heat
ρ - represents desity
Cp - reprezents the specific heat
Δt - represents the difference of temperature (fluid and laboratory).

The specific heat and density of the water will be taken from tables and the two values for the temperature will be read from the instrument's screen.

After obtaining whole data the students must fill a table and draw a graphic on graph paper.

a. Laboratory 1 - Determination temperatures

The aim of this Laboratory is highlighting how measuring the temperature of the working fluid (water) using several types of thermometers (digital, liquid, spring). Read temperatures indicated by each measuring instrument from 5 to 5 minutes for 30 minutes! Focus all data obtained in a table and on a graph paper plot the graphics of temperature - time for each instrument separately. In the end you should switch all the data thru all the temperatures scales.

b. *Laboratory 2 - Determination of flow*

The aim of this Laboratory is highlighting how measuring the flow passing through the different pipes that make up experimental stand, using several types of

flowmeters. First we show the types of pipes that make up the experimental stand with material type, thickness and diameter. Start the circulation pump with electro open 100%. Flow measurements are made at all points indicated and pass a table. The same measurements but with electro-open 75%, 50% and 25%. Plot a graph on graph paper for each type of pipe and diameter. The chart will be Flow -%.

c. *Laboratory 3 - Determination of pressure.*

The purpose of this laboratory is to determine pressure throughout the experimental stand depending on the valve position adjustment. Start the boiler and leave the valve on position normally open 100%. Make the readings on pressure switches (including the boiler). Stops heating and open/close valves separating the stand from the central heating. Start the recirculation pump and closes electro valve nr. 1 at 75%. Make the readings of flow, temperature and pressure. Then continue with the two closed valves as 10% -90% ;20% -80% ;50% -50% and 25% -75%. For all these situations measure temperature, flow and pressure. All data are passed in a table. On paper millimeter will draw graphs T-%; Q-% and P-% for each situation.

5. CONCLUSIONS

Being given the structure of the stand which serves to the gain of practical skills of the future marine engineers graduating in CMU, it is possible to use a multiplicity and diversity of measurement devices for pressure, temperature and flow.

The works which are available according to the given structure are a good start for the future professionals which are joining the board of ships shortly after, as cadets.

6. REFERENCES

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COMPARATIVE STUDY OF A TRANSMISSION SCREW BY USING FINITE ELEMENTS ANALISYS

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ABSTRACT

The screws are not a human kind most recent inventions. The first screws were used perhaps by Archimedes in 200BC for the pumps to lift water from a river to a field. By time the application of screws in many fields of technical applications evolved fulfilling many functions in all kind of machinery including the mechanical presses which are the subject of this paper.

The purpose of this article is to perform the analysis in two ways: first by performing theoretical calculation and secondly analysis using the Finite Element Analysis (FEA) with ANSYS in order to see which the differences are by comparing the results. The calculated maximum equivalent stresses inside the screw are with 67% bigger when deploying FEA than the theoretical ones and with 87% bigger as regard the buckling safety coefficient. This is due to the simplified models deployed for theoretical analysis whereas for the FEA the model is very near to the real geometry and loading. The purpose of this article is to perform the analysis in two ways: first by performing theoretical calculation and secondly analysis using the Finite Element Analysis (FEA) with ANSYS 15, in order to see which the differences are by comparing the results. The Ansys software is an accurate software for analysis of mechanical parts because with it you can control and see how your part behave after applying a certain amount of force. A very good conclusion is also regarding the distribution of stress and strain along spires because they propagate from one spire to another and the last spire is the one which is not subjected to a big amount of stresses and strain.

Keywords: *Stress Analysis, Buckling, Finite Element Analysis, Power Screw.*

1. INTRODUCTION

The screws are not a human kind most recent inventions. The first screws were used perhaps by Archimedes in 200BC for the pumps to lift water from a river to a field. By time the application of screws in many fields of technical applications evolved fulfilling many functions in all kind of machinery including the mechanical presses which are the subject of this paper.

A power screw (also called translation screws) is by definition a drive, used in machine building, to convert the rotary motion into translation motion and a torque to an axial force.

The main characteristic of a screw is its thread. We can distinguish by judging the profile in axial cross section, the square thread form, trapezoidal thread form, metric trapezoidal thread form, buttress thread form but for our paper we are going to use trapezoidal thread in order to see how the stresses are distributed axially long the screw from one spire to another. The phenomenon of buckling (loosing of geometrical stability) after applying a certain force at the top of the screw will be dealt as well.

The purpose of this article is to perform the analysis in two ways: first by performing theoretical calculation and secondly analysis using the Finite Element Analysis (FEA) with ANSYS, in order to see which the differences are by comparing the results.

2. THEORETICAL CALCULATION

In this part we will see what stress condition and buckling condition are in place according to the geometry. All the parameters and allowable stresses for the material will be given as well.

The screw to be analysed is a part of a press and has the following geometrical characteristics [1],[2]:

- Minor diameter: d_3 = 18,5 mm;
- Major diameter: d = 24 mm;
- Pitch diameter: d_2 = 21,5 mm;
- Pitch (distance between two pick of thread): p = 5 mm;

For finding the stress we need to compute the stress σ_i and the torque τ_f as follow:

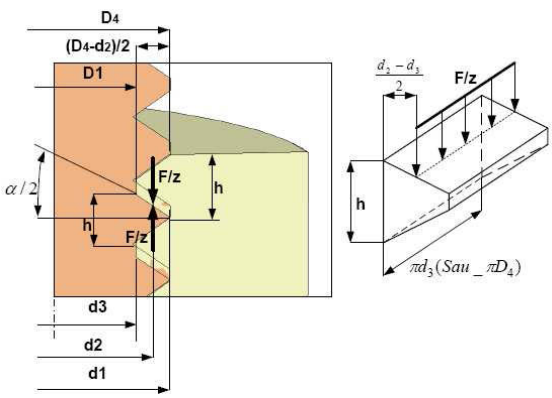

Figure 1 The theoretical model for calculation [1]

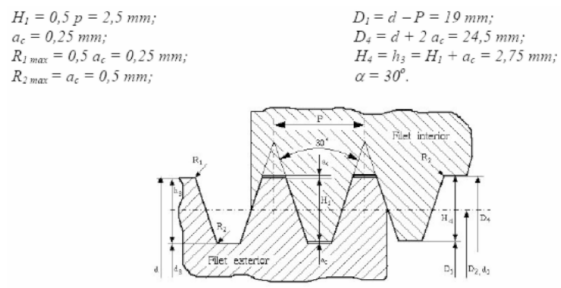

Figure 2 Filet Trapezoidal [1]

$$\sigma_i = \frac{\frac{F}{z} \times l_i}{W} \quad (1)$$

$$l_i = \frac{H_1}{2} + a_c \Rightarrow l_i = 1{,}5\,mm \quad (2)$$

$$W = \frac{\pi d_3 \left(\frac{p}{2} + 2\, l_i\, tg\,(15°) \right)^2}{6} =$$

$$= \frac{18{,}5\pi \left(\frac{5}{2} + 2 \times 1{,}25 \times 0{,}267 \right)^2}{6} = 105{,}733 mm^3 \quad (3)$$

$$\sigma_i = \frac{24000 \times 1{,}5}{9 \times 105{,}733} = 31{,}526 Mpa$$

$$\tau_f = \frac{F}{\frac{z K_m}{A}} \quad (4)$$

$$A = \pi d_3 \left(\frac{p}{2} + 2 l_i tg(15°) \right) \Rightarrow A = 192{,}017 mm^2 \quad (5)$$

$$\tau_f = \frac{20000}{0{,}6 \times 9 \times 192{,}017} = 19{,}288 Mpa$$

The equivalent stress may be calculated using an equivalency theorem

$$\sigma_{ech} = \sqrt{\sigma_i^2 + 4\tau_f^2} \le \sigma_a \quad (6)$$

Where

$$\sigma_a = \frac{\sigma_c}{c_c} \quad (7)$$

For steel $\sigma_c = 250 Mpa$ and $c_c = 1{,}5 \div 3$ we will pick $c_c = 3$ for the worst scenario and $\sigma_a = 83{,}333 Mpa$

$\sigma_{ech} = 40{,}536 Mpa < 83{,}333 Mpa = \sigma_a \Rightarrow$ The screw fillets are resisting combined stresses.

In general for long screws used in transmissions is mandatory to conduct a bucking check since buckling is a major failure mode that may happen in functioning.

Let find first of all slenderness ratio to determine in which region the buckling will occur as follow

$$\lambda = \frac{l_f}{i_{\min}} \quad (8)$$

Where $l_f = 0{,}5 \times l_c = 135 mm$ which is the bucking length.

$$i_{\min} = \sqrt{\frac{I_{\min}}{A}} = 4{,}625 mm \quad (9)$$

Is the minimum inertia radius.

Where $A = \frac{\pi d_3^2}{4} = 268{,}802 mm^2$ (10)

and $I_{\min} = \frac{\pi d_3^4}{64} = 5749{,}853 mm^4$

(11)

then $\lambda = \frac{135}{4{,}625} = 29{,}189 < 85 = \lambda_0 \Rightarrow$ the buckling will happen within the plastic domain and for the steel we considered that we have ($\lambda_0 = 85$)

We will calculate the safety buckling coefficient c_f

$$c_f = \frac{F_f}{F} \ge c_{fa} \quad (12)$$

Where $c_{fa} = 3 \div 5$ is the allowable safety coefficient and $F_f = \sigma_f \times A$ which is a critical load for buckling

$\sigma_f = a - b \times \lambda$ Where $a = 449 Mpa$ and $b = 1{,}67 Mpa$

$\sigma_f = 449 - 1{,}67 \times 29{,}189 = 400{,}254 Mpa \Rightarrow$

$F_f = 400{,}254 \times 268{,}802 = 107589{,}299 N$

$$c_f = \frac{107589{,}299}{20000} = 5{,}379 > 5 = c_{fa} \Rightarrow \quad (13)$$

The screw will resist buckling.

2. THE COMPUTER AIDED DESIGN (CAD) MODEL

In order to do analysis with the FEA simulation, we must generate the CAD model. We will use the SolidWorks 2016 software to generate a press from where we extract the power screw as it is shown in the picture below:

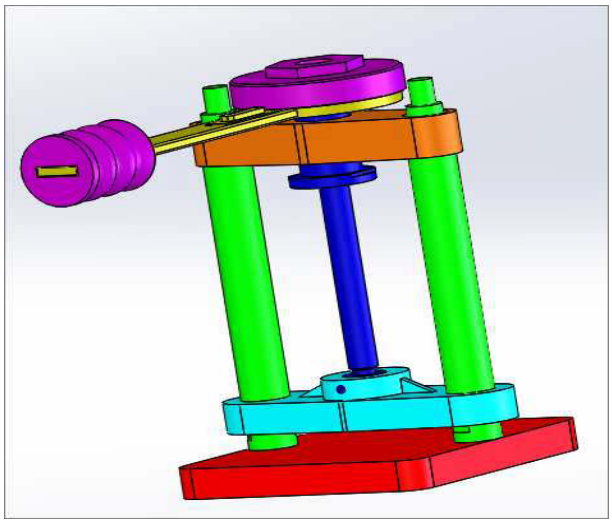

Figure 3 CAD Model for the mechanical press in SolidWorks 2016 [1]

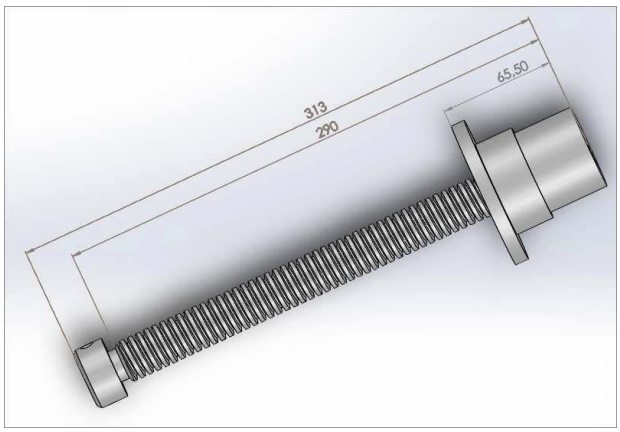

Figure 4 CAD Model for the power screw in SolidWorks 2016

Our screw has an overall length of 313 mm and diameter 18,5 mm as per the standard ASME/ANSI B1.5-1988: pitch of 5 mm and the angle between threads is 30° and for the nut we have an overhaul length of 65,50. For further analysis this CAD geometry has been export to ANSYS Workbench.

3. THE FEA MODEL

First of all the material proprieties are to be defined. The screw is made of Structural Steel with the mechanical properties as defined below:

Table 1 Structural Steel Mechanical properties

Proprieties	Value	**Units**
Density	7850	Kg/m^3
Young Modulus	2,07E+11	Pa
Poisson's ratio	0.3	
Shear Modulus	7,9615E+10	Pa
Bulk Modulus	1,725E+11	Pa
Tensile yield strength	2,5E+08	Pa
Tensile ultimate strength	2,5E+08	Pa
Limit rupture in traction	4,6E+08	Pa

The finite elements meshing is given in the Figure 4 comprising 34972 elements with 59918 nodes

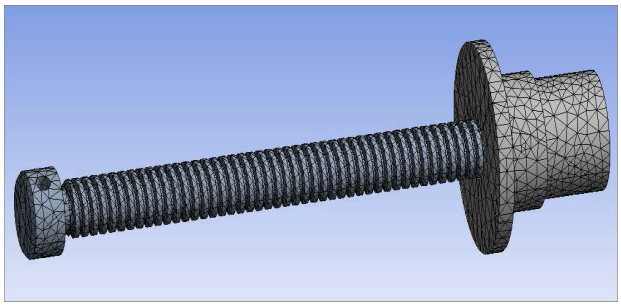

Figure 4 Finite element meshing

For the static structural analysis in ANSYS the loads and supports are provided like in the figure below:

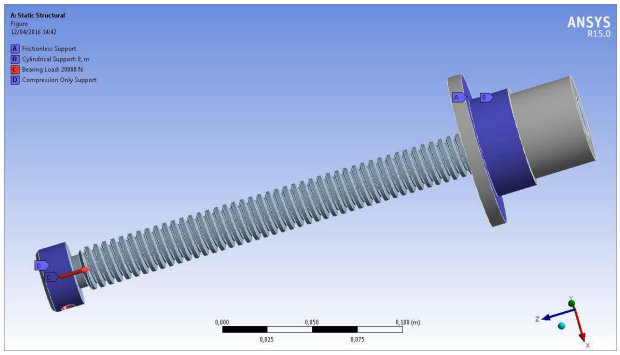

Figure 6 Boundary conditions for the static structural model

The bigger part of the nut is modelled with a frictionless support (A on the figure).

The part of the nut without thread is modelled as cylindrical support (B on the picture).

The head of the screw is modelled with compression only support (D on the picture).

The hole at the head of the screw is subjected to a bearing load of 20000N (because it is apply invers to the direction of axis z it will be consider with a negative sign as shown in the picture).

The contact status between the nut and the screw threads is with friction with the friction coefficient of 0.11.

4. THE STATIC STRUCTURAL MODEL RESULTS

After the bearing load of 20000N is applied we will make a transversal section in order to see what happened. on the threads and the body of the screw for the stress distribution and the strain distribution

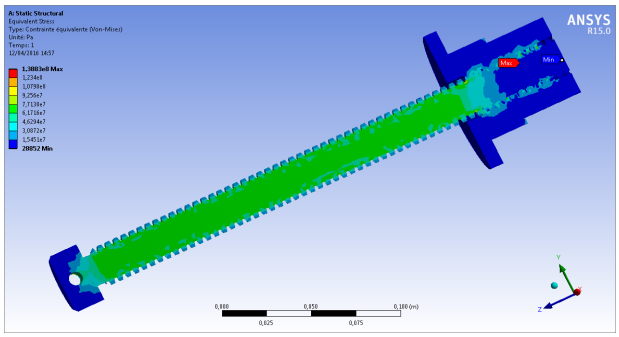

Figure 7 Equivalent stress distribution

We can see that the maximum stress of value 1.3883e8 Pa coloured in red is among the last spires of the thread and the minimum stress of value 28852 Pa coloured in blue is at the bottom most part of the screw. In the midsection of the screw stem the maximum calculated equivalent stress is 67 MPa.

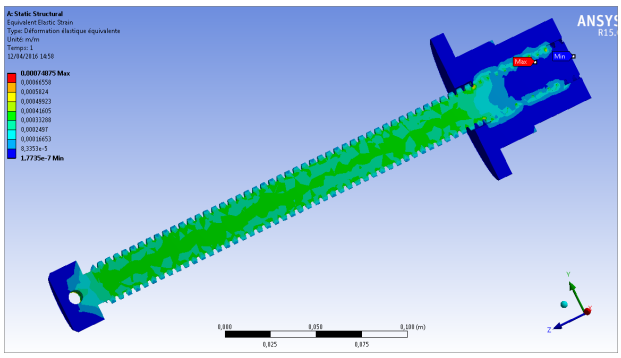

Figure 8 Equivalent elastic strain distribution

As seen above the peak of the equivalent strain is reached among the last spires of the screw and has the value of 0.00066558, the minimum value of 1,7735e-7 is at the bottom most part of the screw.

The same distribution is followed by the equivalent elastic strain as seen in the Figure 6.

The distribution of the stress along the nut threads is shown in the figure above, from where one may see that the first thread is loaded 58 MPa whereas the last one is subjected only to 37 MPa.

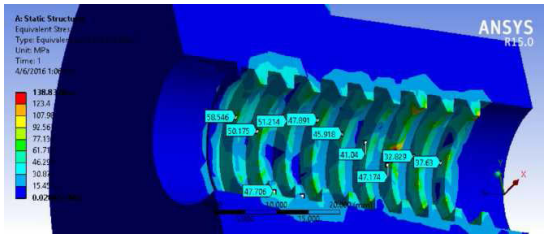

Figure 9 The equivalent stress distributed among the nut threads

5. THE BUCKLING PHENOMENON

In order to study the buckling phenomenon which is basically the loses of elastic stability we will take the nut and the screw as a bounded single part for our analysis that means new geometry and new boundary conditions. After doing the Static Structural analysis we will import the result for structural analysis to linear buckling module as shown in the picture below.

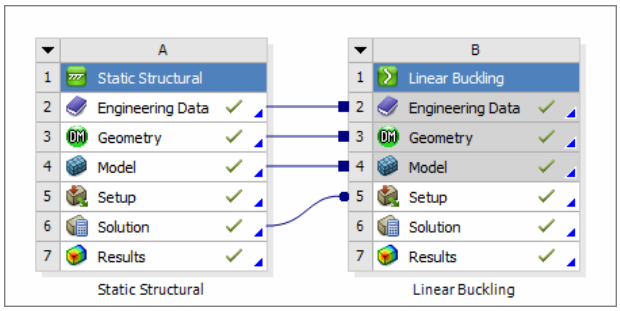

Figure 10 Static Structural integration in linear buckling

For the buckling phenomenon we will have another value of the boundary conditions as shown in the picture below.

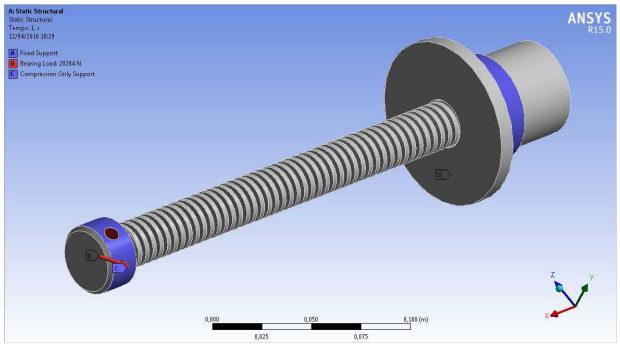

Figure 11 Boundary conditions for buckling

For the static analysis we change the value of the bearing load which has the value 28284N now and we remove the frictionless support because the two material are fixed together.

We will see next how this boundary condition change the equivalent stress and strain.

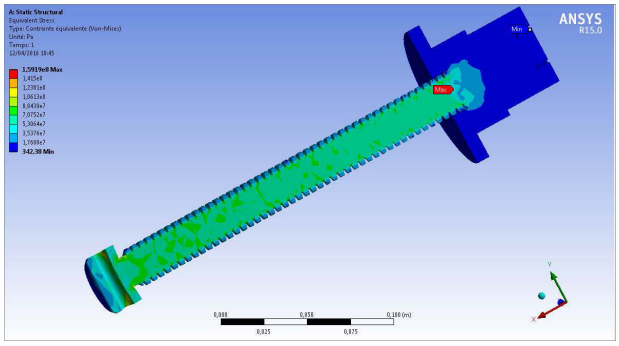

Figure 12 Equivalent stress distribution

The maximum stress 1,415e8 Pa is somewhere around the first contact of the screw and the nut as shown in the picture below in red. And the minimum value in blue of 348,28 Pa is at the last spires of the screw.

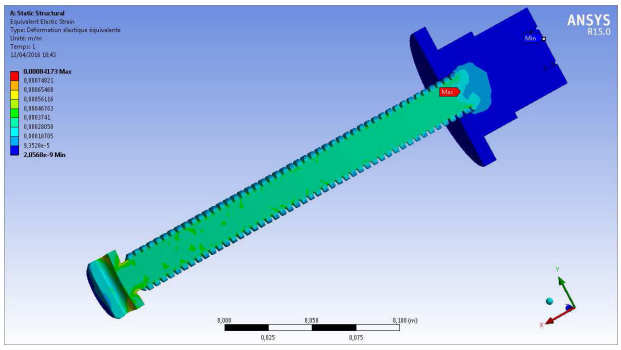

Figure 13 Equivalent elastic strain distribution

For the strain distribution the maximum value 0,00074821 in red remain may be at the same point and the minimum value of 2,0568e-9 at the bottom of the screw.

After all the computation from Ansys regarding the buckling the result is displayed below

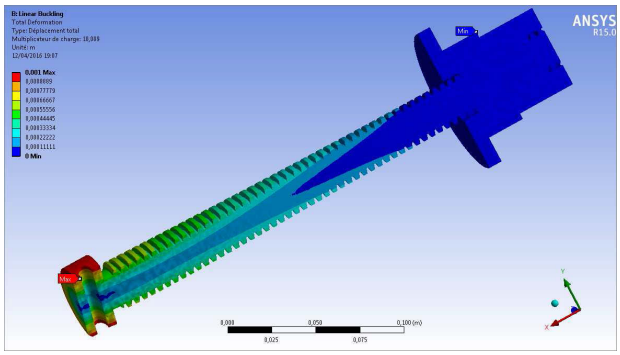

Figure 14 Calculated buckling with Ansys

We can see that the maximum value for buckling is located at the top of the screw and has the value 0,001 coloured in red and the minimum value is the located at the left most edge of the second cylinder of the nut and has the value 0,00011111 coloured in blue.

The maximum safety coefficient calculated is 10.

6. CONCLUSIONS

In comparison between the theoretical analysis and the FEA analysis we have seen that the theoretical aspect give us just the overhaul view on the object and the FEA gives us the almost real behaviour of the part and how is propagating the stress and strain along the screw threads.

Table 2. Comparative results theory vs. FEA

Load	Theory	Ansys	Variation
Equivalent stress [MPa]	**40.53**	**67**	**+67%**
Buckling safety coefficient	**5.37**	**10**	**+86%**

The calculated maximum equivalent stresses inside the screw thread are with 67% bigger when deploying FEA than the theoretical ones and with 87% larger as regard the buckling safety coefficient. This is due to the simplified models deployed for theoretical analysis whereas for the FEA the model is very near to the real geometry and loading.

Ansys software is an accurate software for analysis of parts because with it you can control and see how your part behave after applying a certain amount of force. A very good conclusion is also regarding the distribution of stress and strain along spires because they propagate from one spire to another and the last spire is the one which is not subjected to a big amount of stresses and strain.

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BIOMASS AS A RENEWABLE ENERGY RESOURCE IN CONSTANTA COUNTY

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ABSTRACT

Within Romania–Bulgaria Cross–Border Cooperation Programme 2007–2013, Constanta Maritime University and Varna Business agency have implemented the project Green Energy Cluster Constanta-Dobrich. As a biological solution to green energy in Dobrogea area, the biomass resources were analysed.

The aim of this paper is to highlight the capacity of Constanta County regarding the biomass as a source of renewable energy, in the climate region and the policy context.

Keywords: *renewable energy, biomass, Constanta County.*

1. INTRODUCTION

Renewable energy must play a major role in the global energy supply to meet the increasingly serious environmental and economic threats of climate change, according to a new report from the Renewable Energy Policy Network for the 21st Century.

The key purpose of the Green Energy Cluster "Constantza-Dobrich" project is to establish an innovative environment for the purpose of balanced and sustainable development of small and medium renewable energy production enterprises along the border regions in Bulgaria – Romania with centres Constanta and Dobrich [1]

Biomass, with an important role in renewable energy, is organic matter which derives from recently living or living organisms - plant material and animal waste. Biomass means the biodegradable fraction of products, waste and residues having biological origin from agriculture (vegetal or animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste [2].

Although the most familiar forms of renewable energy are generated by sun and wind, biomass is the oldest renewable energy source in the world and the biggest source of renewable energy in the EU. Biomass is the key resource to achieve the EU 2020 renewable energy targets and the EU long-term decarbonisation politics until 2050. Biomass use in the heat and power sectors is expected to further increase on the medium term, in the context of the EU effort to promote a low-carbon economy until the middle of the century [3].

Biomass is source of renewable energy because its energy comes from the sun (through the process of photosynthesis) and because biomass can re-grow over a relatively short period of time in comparison with hundreds of millions of years necessary for carbon energy to be accumulated in fossil fuels.

In the photosynthesis process, the green pigments of plants (chlorophyll), using sun energy, converts aerial carbon dioxide and ground water into chemical compounds containing carbon, hydrogen, and oxygen (carbohydrates). When these complex organic matters are burned, they release the energy captured in the process of photosynthesis from the sun and turn back into carbon dioxide and water. In this way, biomass functions as a sort of natural battery for storing solar energy.

As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel.

Biomass used like renewable energy source has important environmental advantages in terms of heat and power production. Important quantities of biomass result from domestically produced raw material; hence the installations that convert biomass in heat energy represent new opportunities for the farmers and contribute significantly to sustainable development in rural areas. This is a significant contribution to EU energy security. Furthermore, greater awareness of the value of biomass can motivate small owners to carry out active and sustainable management of their private property.

Reducing greenhouse gas emissions by using biomass energetic resources requires sustainable technologies for biomass processing, starting from the biomass growing to energy biomass conversion.

Also, biomass use for energy production is sustained by the fact that it can be stored when the energy demand is low and provides energy when needed.

According to the estimated values published by The National Renewable Energy Action Plans (NREAPs), it is expected to further increase from 86.5 million tonnes of oil equivalent (Mtoe) in 2012 up to 110.5 Mtoe in 2020. The NREAPs estimates a growth in agriculture biomass for energy, from 13.2 Mtoe in 2012 to 41.7 Mtoe in 2020, equal to a share increase from 14% to 31.6% and, compared to 2006, more with 95 million cubic meters (Mm^3) of wood for energy use by 2020. The relative contribution of biodegradable waste is projected by the NREAPs to increase in absolute terms from 10.8 Mtoe in 2012 to 16.7 Mtoe in 2020 [3]

Despite the multiple benefits regarding biomass like source of renewable energy, there are some sustainability risks that need to be properly managed.

Using biomass for production of bioenergy can affect forest biodiversity and carbon stocks caused by deforestation and degradation due to excessive removal of raw material. The studies on the topic of assessing the

lifecycle GHG emission performance of biomass have a large variability in the results and for this reason can only be identified strategies of forest bioenergy with "low risk" and "high risk". The 2020 EU objective is to ensure that all forests are managed according to the principles of sustainable forest management.

In agricultural activities, the most important part of biomass is supplied from residues and energetic crops and a small part from energy dedicated plantations.

A negative environmental impact may be associated with the straw regarding the competition of its utilization as biomass in the renewable energy sector and its biological role into soil quality, including fertility and biodiversity deterioration.

Energy crop plantations require high fertilization because short rotation of coppice and can have an environmental impact regarding the soil and water quality.

Spontaneous wood burning, incomplete combustion especially, is an important source of air pollutants. In this case particulate matter, persistent organic compounds, polycyclic aromatic hydrocarbons, carbon monoxide, non-methane volatile organic compounds and heavy metals are spread in the environment.

2. RENEWABLE BIOMASS PRODUCTION TOPIC IN ROMANIA

Romania has all kinds of renewable resources that can be used to produce electricity and heat, which might partially be exported to other countries with less energetic resources.

According European Commission, realistic potential of agricultural crop residues in the Romania is the 40.6 Mt/year, derived from: wheat (19.3 Mt/y), barley(4.86 Mt/y), maize (7.34 Mt/y), rye (0.92 Mt/y), oats (0.5 Mt/y), sunflower (0.83 Mt/y), rape (5.93 Mt/y), sugar beet (0.33 Mt/y), wine (0.56 Mt/y) [4].

Conforming Romania National Renewable Energy Action Plan the expected production of electric energy from biomass sources should be 3.65 GWh in 2015. The CNP forecast of 2010 mentioned an expected final energy consumption of 25,885 thousand toe in 2015 and 27,240 thousand toe in 2020 and an expected primary energy consumption of 38,765 thousand toe in 2015 and 40,500 thousand toe in 2020. Expected amount of domestic resource is 6.5 mil.m^3 in 2015 and 7.5 mil.m^3 in 2020, from forestry biomass, and 3.72 mil.m^3 in 2015 and 3.76 mil.m^3 in 2020, from agricultural by-products.

Evaluation regarding the total expected contribution of biomass renewable energy technology to meet the binding 2020 targets, show an increase amount of installed power from 425 MW in 2015 to 600 MW in 2020 and the produced energy from 2050 GWh in 2015 to 2900 GWh in 2020 [5].

3. ENVIRONMENTAL CONDITIONS IN CONSTANTA COUNTY

3.1 Climate

Constanta County, part of the Dobrogea region, is located in an area with a temperate continental climate.

The Black Sea climatic influences extend 40–60 kilometers from the coast.

The influences of the Black Sea on the Dobrogea climate determine the values of the following parameters to decrease from west to east: maximum absolute temperature, range of annual mean temperature, annual mean precipitation and atmospheric calm. On the same direction, there are spatial increasing variations of wind speed, mean annual temperatures, insolation and solar radiation, or duration of dryness and drought phenomena [6].

The average annual temperatures range from 11 °C inland and along the Danube to 11.8^{0}C on the coast and less than 10°C in the higher parts of the Dobrogea Plateau.

The climate of Dobrogea Plateau has a semiarid character, especially in the eastern side, characterized by long periods of dryness and drought with mean annual precipitation values below 400 mm [6]. The precipitation may be absent in any month of the year, or even on several months in a row, usually during the warm season. More, Constanta is a windy county that causes the decreasing of soil moisture.

3.2 The soil

Soil is the core of terrestrial ecosystems, the primary support for life on Earth.

Today, the role of soil is widely accepted, not only in promoting and developing sustainable agriculture, in maintaining environment quality, in global climate change, in biodiversity conservation, but even in the economy development as a whole.

Soil has three main active ecological functions: production of biomass, environmental protection and living environment and the provision of genetic reserve for plant and animal organisms.

As a result of the action and processes caused by environmental factors, soil continuously adapts to changes in natural or artificial environment, recording and storing the main events of this evolution.

Physical-geographical conditions of Romania have a great diversity for the main landforms (plains, hills, mountains), resulting in a wide variation of attributes such as altitude, slope, land use types (edaphic units, as well as quantitative and qualitative characteristics.

In Romania, most agricultural soil is located at altitudes between 0 and 1200 m; for the whole country, most sites are grouped at altitudes between 0-1000 m. About 35% of analyzed plots are located on nearly level – very gently sloping agricultural land, over 5%, vulnerable to erosion and sliding processes.

For the agricultural land, most surfaces are found on arable land (65.7%) and grassland (21.0%), for the others land uses, the distribution being as follows: meadows – 10.3% vineyards – 1.0%, orchards – 2.0% [7].

According to the results obtained by the "Agricultural Soil Monitoring System", most of the lands in Constanta County are arable with cernisol type soil [7].

4. CONSTANTA BIOMASS SOURCES AND THEIR POTENTIAL

In the Constanta area the biomass has an energy potential about 125 Terrajoule and is provided by agricultural activities (more than 99%) due to the fact that the forest area is poor [8].

Considering the last General Agricultural Census from 2010, in the Constanta County the main feature of the agricultural units that produce biomass is the fragmentation of the land (there are more than 45000 farms). This fact is an obstacle for an efficient use of biomass for energy purpose. Crop lands in the Constanta County means more than 500000 ha [9].

Table 1. Cultivated lands in the Constanta County (2014)

	Wheat	Barley	Corn	Sunflower	Rape	Potato	Tomatoes
Cultivated areas [ha]	176197	28625	52815	90123	34525	1500	615
Production [kg/ha]	3185	3315	3211	1806	1610	13666	23252

Source: original data from DADR Constanta provided on request

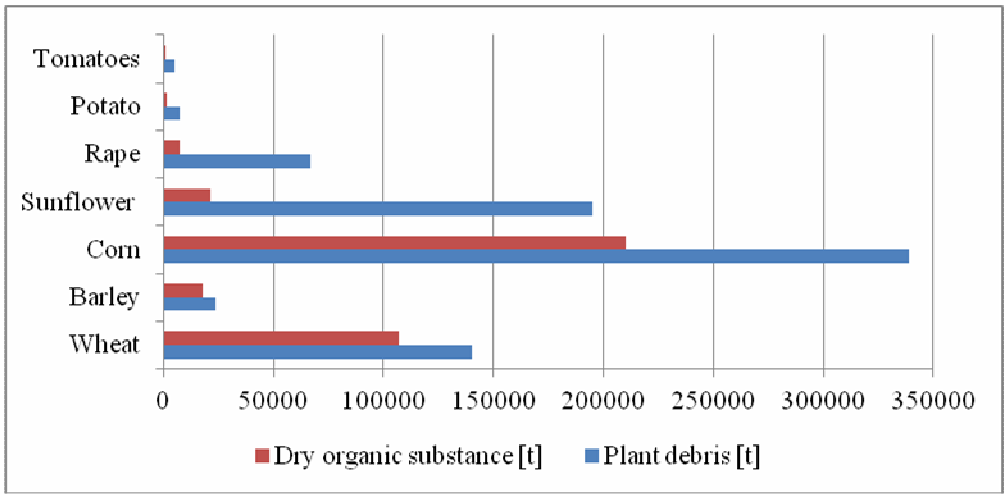

Figure 1 Plant debris production in the Constanta County

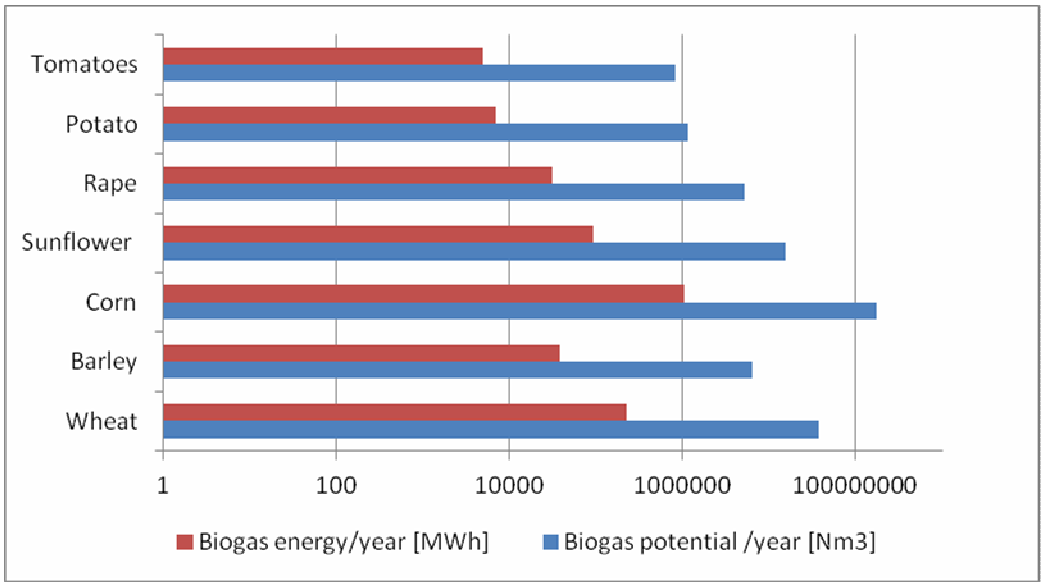

Figure 2 Potential of biogas energy production from plant debris in the Constanta County

The most important agricultural crops in the county are corn, wheat, sunflower, barley, rape, potato and tomatoes (table 1); that means a total potential about 239 millions Nm^3 biogas/year or a biogas energy production of 1,432,112 MWh/year (fig. 1 and fig. 2).

In the Constanta County the livestock means about 2,413,159 heads (table 2), that means a potential of biogas energy production from animal waste of about 296887 MWh/year (fig. 3).

Table 2. Livestock in the Constanta County

	Cattle	Sheep	Goats	Pigs	Poultry	Horses
Agricultural holdings (number) with livestock	4868	3583	3684	17575	32750	8901
Livestock (number)	32879	251583	81183	103126	1933987	10401

Source: National Institute of Statistics, 2013

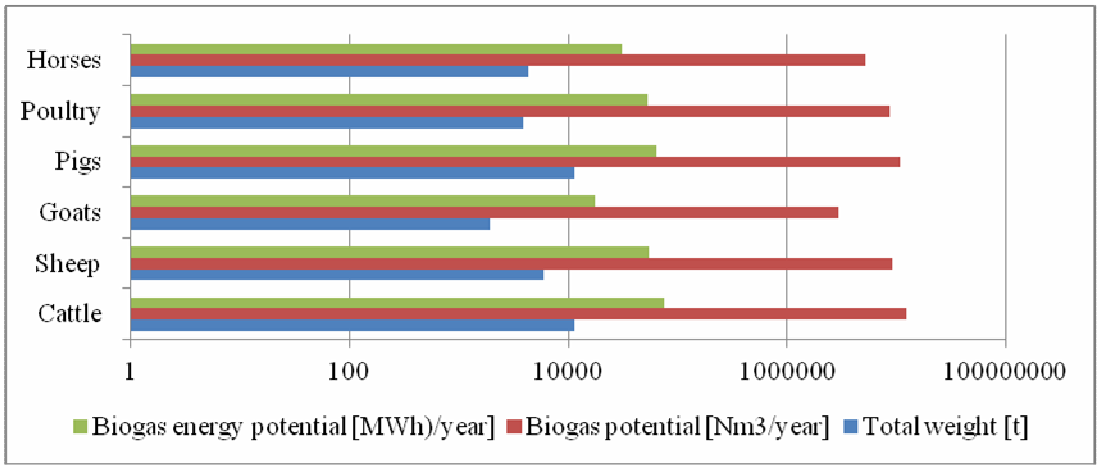

Figure 3 Livestock and the potential of biogas energy production from animal waste in the Constanta County

Even that the biomass energy potential is important there are only a few little farms which use technologies for renewable energy production in Constanta County (source: National Institute of Statistics, 2013): the village Aliman less than 1 ha and the village Saligny less than 1 ha.

The amount of obtained biomass depends, among other things, especially on the climatic conditions and the soil quality in the region.

5. CONCLUSIONS

In the last years, in Romania it was observed a trend of expansion of biofuel crops but with negative effect by the reduction of cultivated areas for food.

The EU policy and the Romania National Renewable Energy Action Plan for using biomass as renewable energy resource create opportunities for this sectorial development in the future. Despite the fact that there aren't clear strategies regarding the cultivation of energetic plants, managing the plants debris or animal waste, the Constanta County has the infrastructure and the logistics appropriate this topic.

6. ACKNOWLEDGMENTS

This study took place in the framework of the Green Energy Cluster "Constanta-Dobrich" project.

I thank Constanta Department of Agriculture and Rural Development (DADR) staff for providing information on cultivated land.

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APPLICATION OF WATER QUALITY MODEL QUAL2K ON THE DANUBE RIVER

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ABSTRACT

This study is focused on the aquatic pollution of the Danube River due to the discharged cooling water from Nuclear Power Plant Cernavoda and to the local Waste Water Treatment Plant. The modified parameters cannot be observed continuously in real time and that's why an acceptable approach could be a simulation model which can predict substantially modifications of the water quality along the river.

The present study evaluates the capabilities of QUAL2K water quality model to simulate with higher fidelity the pollution processes in this aquatic area.

Keywords: *Danube River quality, simulation software, QUAL2K.*

1. INTRODUCTION

The Danube River is the most important aquatic ecosystem in the centre of Europe and the main river in Romania, having large influences over the aquatic environment and social life. There are a lot of polluting sources along the river, but the studied area near Cernavoda City is entirely included into the Romanian territory and the main pollutants are the cooling water of The Nuclear Power Plant (NPP) and the discharged water from urban Waste Water Treatment Plant.

Cernavoda Nuclear Power Plant cooling system has polluting effects over the river mainly by the higher temperature of the discharged water, after passing through the cooling system. The discharged water coming from Waste Water Treatment Plant loads the river with solids and dissolved pollutants. The two polluting sources modify the physical-chemical and biological parameters of the river water, but these effects cannot be observed continuously in real time. Using simulation models, substantially modifications of the water quality along the river can be predicted. Water quality modeling is increasingly recognized as an effective tool for water quality management decision-making [1].

This study evaluates the capabilities of QUAL2K water quality model to simulate with higher fidelity the pollution processes in this aquatic area. Pelletier *et al.* [2] confirmed the flexibility and applicability of the QUAL2K model for simulation of river water quality. Some successful examples of QUAL2K have also been published in recent years [3, 4].

QUAL2K is a stream water quality model promoted by U.S. Environmental Protection Agency (EPA), as a freeware application [5]. It is used for environmental impact assessment of the multiple pollutants discharged along the rivers by urban wastewaters, sewers, runoff, and storm waters or caused by anthropogenic activities.

QUAL2K was developed by Steve Chapra, Greg Pelletier and Hua Tao [5] in connection with the Environmental Protection Agency and Tufts University. The model is written in MS Windows Visual Basic, the Microsoft Excel is used as the graphical user interface and input and output data are organized in worksheet tabs.

The programming language Fortran 90 was used to implement the algorithms of the model, for shortening the time of calculation and to assure the portability of the program on computers with other operation systems than MS Windows. QUAL2K has been several times upgraded to eliminate software bugs or to enhance the model with new aquatic organisms or environmental processes such as new BODs types, sedimentation, alkalinity. The model is one-dimensional using steady-state equations with spatial variable x along the river, which implies the assumption that the components in the water are fully-mixed in every transversal section of the river body. Also it is assumed that the hydraulic parameters and the concentrations of the aquatic components are constant over the time scale of the simulation period.

The architecture of QUAL2K model is complex including many specific processes such as water quality kinetics, chemical equilibrium, advection, dispersion, settling, and interactions with the atmosphere and riverbed which simulates the distribution of chemical and biological water pollutants by solving the mass balance equations. The aquatic pollution can be assessed by the evaluation of the spatial distribution of the main output parameters: carbonaceous biochemical oxygen demand (CBOD), suspended solids, algae, pathogens, phytoplankton and detritus, nitrogen and phosphorus species.

Following the User Manual of QUAL2K, it is necessary to be introduced into the program various input parameters such as river hydraulics which includes channel length, elevation, widths, slopes, and roughness used by Manning's type equations [6]. Also it is necessary to be set up the rates and constants of the pollutants sources, CBOD decay coefficients, re-aeration rate, algal growth rate, turbulent eddy diffusivity, and settling velocity.

Output data predicted by QUAL2K model are spatial and temporal distributed along the river, being constant on each defined segment during specified period of time. There are output graphs and tabs available at the end of the simulation.

2. METHODS

2.1 Study area

The aquatic area explored in this study is situated in the North part of Cernavoda City, including the Danube River segment between Cernavoda Harbor and Dunarea village and also the surface part of the cooling water discharge channel of NPP Cernavoda (Figure1).

From geographic point of view, this zone is a T junction between the Discharge Channel containing polluting waters and the Danube River, upstream and downstream of the aquatic junction.

Figure 1 Sampling points and aquatic segments on the Discharge Channel and the Danube River

Table 1. Geographic data of aquatic segments on the Discharge Channel

	Number		12	23	34	45
	length	(km)	2.50	0.10	0.43	0.43
Location	Latitude	Decimal units	44.367	44.368	44.370	44.373
	Longitude Est.	Decimal units	28.047	28.046	28.042	28.038
	Upstream	(km)	3.460	0.960	0.860	0.430
	Downstream	(km)	0.960	0.860	0.430	0.000
Elevation	Upstream	(m)	5.310	5.300	5.290	5.250
	Downstream	(m)	5.300	5.290	5.250	5.240
Weir	Height	(m)	0.0000	3.5000	0.0000	0.0000
	Width	(m)	0.0000	60.0000	0.0000	0.0000
	adam	(m)	1.2500	1.2500	0.0000	0.0000
	bdam	(m)	0.9000	0.9000	0.0000	0.0000
Manning formula	Side slope		0.00020	0.00015	0.00015	0.00015
	Manning	n	0.0350	0.0350	0.0400	0.0400
	Bottom Width	(m)	15.00	90.00	40.00	40.00
	Side slope		1.5000	0.7500	0.7500	1.0000

The two main aquatic branches were divided in appropriate hydraulic segments, with assuming constant parameters, necessary for QUAL2K simulations. The Discharge Channel was divided into 4 aquatic segments and the studied Danube river zone was divided into 5. The marked points on the Discharge Channel (1, 2, 3, 4, 5) and on the river (A, B, C, D, E, F) represents sampling sites for monitoring real measured parameters. For each measured or predicted parameter, the value on an aquatic segment was assumed the average between the values measured or estimated in both end points of that segment.

Each aquatic segment is characterized by length, trapezoidal cross section, slope and friction forces (in the sense of Manning hydraulic equation). Other hydraulic input data sets introduced in QUAL2K files include the water flow at the input of the Channel and on the river (Tabel 1. and Table 2.) Data on the Discharge Channel includes parameters of the water fall due to the weir in the segment 23. The ranges of model rate parameters were obtained from guidance modeling documents [7].

Table 2. Geographic data of aquatic segments on the Danube River

	Number		AB	BC	CD	DE	EF
	length	(km)	0.83	0.82	1.40	0.72	7.27
Location	Latitude	Decimal units	44.368	44.374	44.385	44.390	44.44
	Longitude Est.	Decimal units	28.028	28.034	28.044	28.050	-28.11
	Upstream	(km)	11.032	10.204	9.382	7.982	7.265
	Downstream	(km)	10.204	9.382	7.982	7.265	0.000
Elevation	Upstream	(m)	5.500	5.400	5.300	5.200	5.100
	Downstream	(m)	5.400	5.300	5.200	5.100	4.900
Manning formula	Channel slope		0.00020	0.00015	0.00014	0.00012	0.00010
	Manning	n	0.0500	0.0500	0.0500	0.0530	0.0450
	Bottom Width	(m)	506.00	567.00	438.00	465.00	532.00
	Side slope		11.5000	10.8300	16.3000	14.0000	4.7500
	Side slope		0.0000	0.0000	7.4000	14.2500	21.0000

2.2 Sampling and analysis

During the summer of 2014, between June/28 and September/3 samples of water and temperature data were collected in the described aquatic area, in each point or spatial distributed in the cross section and along each aquatic segment. Also this sampling data were temporally mediated to obtain more realistic steady state values of parameters.

The data for flows, velocity and the cross section profiles of the river have been obtained from Galati Lower Danube River Administration and constructive data of the Discharge Channel by consulting official design documents of NPP Cernavoda.

The water samples were collected, preserved, conveyed and monitored in accordance with the standard methods [8].

A basic set of parameters was choosen to compare the real data against predicted data, that includes: dissolved oxygen (DO), slow and fast biodegradable carbonaceous biochemical oxygen demand (CBODs CBODf), ammonium nitrogen (NH4-N), nitrate-nitrogen NO3-N, organic phosphorus (OP), phytoplankton (Phyto), bottom algae, pH, inorganic suspended solids (ISS), water temperature (T), and flow.

The data resulted from laboratory analyses were statistical evaluated and simulations by QUAL2K software application were made to calibrate this model.

3. RESULTS AND DISCUSSION

Sampling data on the Discharge Channel (Table 3) and Danube River (Table 4) are compared with simulated data provided by QUAL2K.

The simulated results (predicted by the model) are presented as continuous lines and the measured data as punctual symbols. From the results it can be observed that the values predicted by QAL2K model are in close correlation with the measured values, except a few sampling points or parameters.

Inorganic solid substances (ISS) had more values of concentration on the Discharge Channel than on the Danube River, due to the cooling water pumps of NPP which absorbed more solid matter (Fig.2a and Fig.2b). The output values of QUAL2K model had good correlation with the measured data.

Dissolved oxygen (DO) had lower values on the Discharge Channel, mainly the cause being the higher temperature of the water on the Channel than on the Danube River. In the aquatic area of the water fall, the DO concentration was slowly higher due to the aeration process, but then it decreased fast because the high water temperature eliminates the dissolved oxygen (Fig.3a and Fig.3b). QUAL2K model simulated with accuracy DO parameter along both aquatic branches.

Table 3. The Discharge Channel water quality and flow data

Distance (km)	*DO-O2K (mgO_2/L)*	*DO-Average (mgO_2/L)*	*ISS-O2K (mgD/L)*	*ISS-Average (mgD/L)*	*CBODs-O2K (mgO_2/L)*	*CBODs-Average (mgO_2/L)*
3.34	6.96	6.85	13.98	13.80	2.54	2.70
2.09	6.89	6.80	13.89	13.50	1.93	1.90
0.91	7.15	7.05	13.77	14.10	1.35	1.25
0.32	7.18	7.00	13.69	13.60	1.19	1.10
0.11	7.15	6.85	13.67	13.90	1.04	0.90
Distance (km)	*NH4-O2K (µgN/L)*	*NH4-Average (µgN/L)*	*NO3-O2K (µgN/L)*	*NO3-Average (µgN/L)*	*Po-O2K (µgP/L)*	*Po-Average (µgP/L)*
3.34	161.13	164.00	181.84	178.00	62.87	61.00
2.09	152.15	149.00	190.67	200.00	62.24	60.00
0.91	146.74	142.00	233.36	220.00	66.59	63.00
0.32	143.00	140.00	236.84	225.00	66.23	62.00
0.11	139.39	145.00	240.17	235.00	65.86	61.00
Distance (km)	*Bot Algae-O2K (mgA/m^2)*	*Bot Algae-Average (mgA/m^2)*	*pH-O2K*	pH-Average	*Temp-O2K (°C)*	*Temp-Average (°C)*
3.34	5.94	5.00	7.58	7.40	30.99	29.50
2.09	7.69	10.00	7.72	7.54	30.96	28.80
0.91	0.40	14.00	8.04	8.20	30.90	32.00
0.32	42.26	39.00	8.16	8.00	30.88	30.00
0.11	45.63	50.00	8.15	7.90	30.86	29.60
Distance (km)	*CBODf-O2K (mgO_2/L)*	*CBODf-Average (mgO_2/L)*	*Phyto-O2K (µgA/L)*	*Phyto-Average (µgA/L)*	*Depth-O2K (m)*	*Velocity-O2K (m/s)*
3.34	0.15	0.10	4.35	4.20	4.36	0.85
2.09	0.71	0.80	4.33	4.40	4.36	0.85
0.91	1.15	0.91	4.29	4.25	7.00	0.13
0.32	1.25	1.30	4.28	4.20	3.13	0.60
0.11	1.32	1.30	4.27	4.30	3.10	0.60

Table 4. The Danube River water quality and flow data

Distance (km)	*ISS-O2K (mgD/L)*	*ISS-Average (mgD/L)*	*DO-O2K (mgO2/L)*	*DO-Average (mgO_2/L)*	*CBODs-O2K (mgO_2/L)*	*CBODs-Average (mgO_2/L)*
10.83	8.59	8.10	7.64	7.50	1.03	0.9
8.68	8.70	8.90	7.98	7.75	0.73	0.85
7.01	8.64	8.68	8.11	8.20	0.53	0.66
5.45	8.58	8.60	8.19	8.40	0.40	0.5
3.37	8.50	8.70	8.25	8.15	0.27	0.35
1.82	8.44	8.30	8.29	8.10	0.20	0.17
Distance (km)	*CBODf-O2K (mgO_2/L)*	*CBODf-Average (mgO_2/L)*	*NH_4m-O2K (µgN/L)*	*NH_4-Average (µgN/L)*	*NO_3-O2K (µgN/L)*	*NO_3-Average (µgN/L)*
10.83	1.36	1.2	311.52	305	813.43	800
8.68	1.58	1.5	286.58	270	812.24	805
7.01	1.65	1.54	270.96	285	827.60	835
5.45	1.63	1.7	257.22	270	841.08	825
3.37	1.55	1.6	239.99	215	857.96	830
1.82	1.46	1.4	227.84	210	869.87	835
Distance (km)	*Po-O2K (ugP/L)*	*Po-Average (ugP/L)*	*Phyto-O2K (ugA/L)*	*Phyto-Average (ugA/L)*	*Bot Algae-O2K (mgA/m^2)*	*Bot Algae-Average (mgA/m^2)*
10.83	139.66	150	27.98	22	1.26	0.5
8.68	135.27	148	27.01	40	0.40	0.2
7.01	133.79	140	26.90	41	0.90	0.6
5.45	132.36	146	26.79	38	1.03	1.7
3.37	130.48	137	26.65	20	1.16	0.8
1.82	129.09	134	26.54	14	1.20	0.7
Distance (km)	*pH-O2K*	*pH-Average*	*Temp-O2K (°C)*	*Temp-Average (°C)*	*Depth (m)*	*Water Velocity (m/s)*
10.83	8.05	7.9	22.00	21.4	5.11	0.80
8.68	8.07	8.2	22.27	22.8	6.15	0.73
7.01	8.08	7.8	22.26	21.3	5.72	0.66
5.45	8.09	8.15	22.26	21.1	5.72	0.66
3.37	8.11	7.85	22.25	21.7	5.72	0.66
1.82	8.12	8.02	22.24	22.4	5.72	0.66

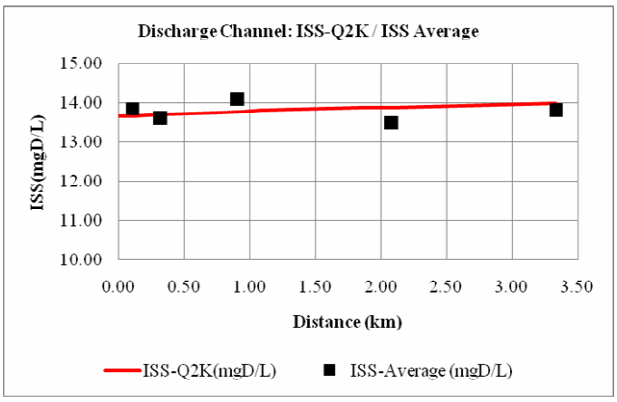

Figure 2a. ISS concentration on the Discharge Channel

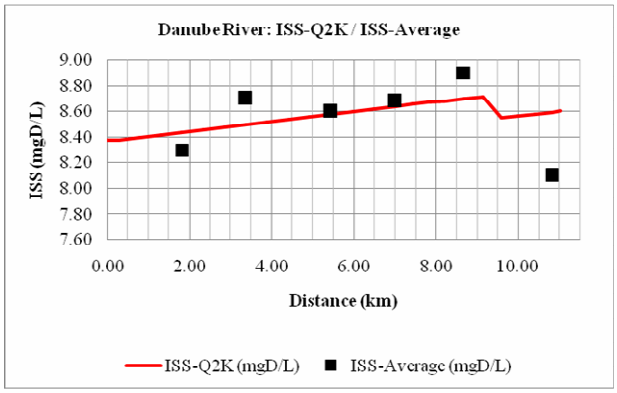

Figure 2b. ISS concentration on the Danube River

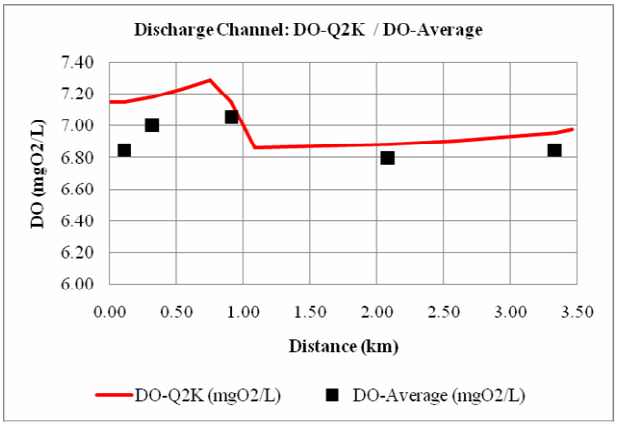

Figure 3a. DO concentration on the Discharge Channel

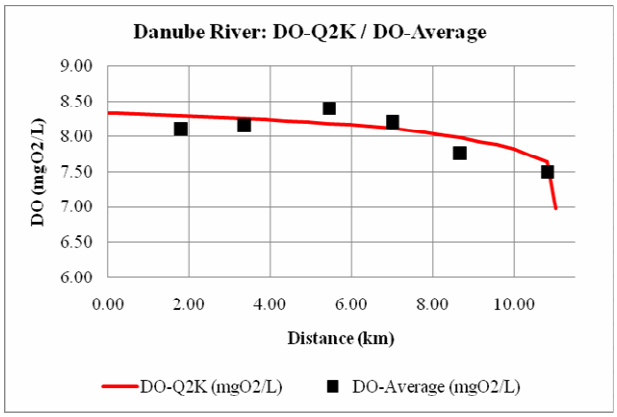

Figure 3b. DO concentration on the Danube River

The values of CBODs (slow biodegradable) decreased on both branches, but the rates are diffrent. A higer value was obeserved after the weir which was caused by the discharged water purificated by the WWTP Cernavoda (Fig.4a and Fig.4b). Should be highligted that this small rising trend of CBODs near the WWTP could not be detected without simulated data of QUAL2K.

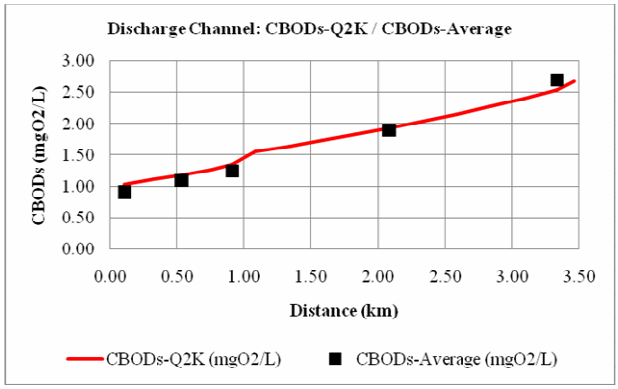

Figure 4a. CBODs on the Discharge Channel

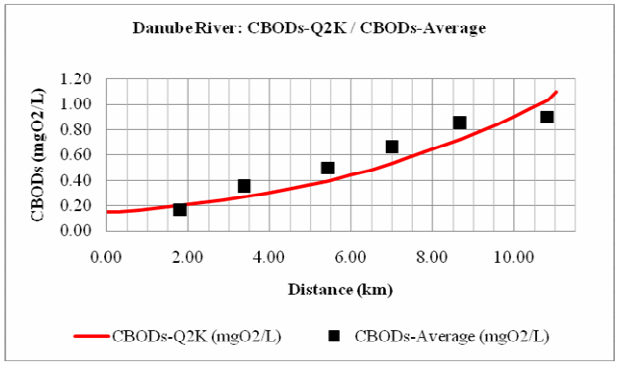

Figure 4b. CBODs on the Danube River

The parameter CBODf (fast biodegradable) has diffrent trents on the the two water branches. There were pick values near the WWTP, this fact being normal. Along the Danube River it could be observed a variation curve having a maximum value near the middle of the studied area (Fig.5a and Fig.5b). In spite of low values of this parameter, CBODf is a good marker for water quality, and the simulations by QUAL2K predict quite well real trends.

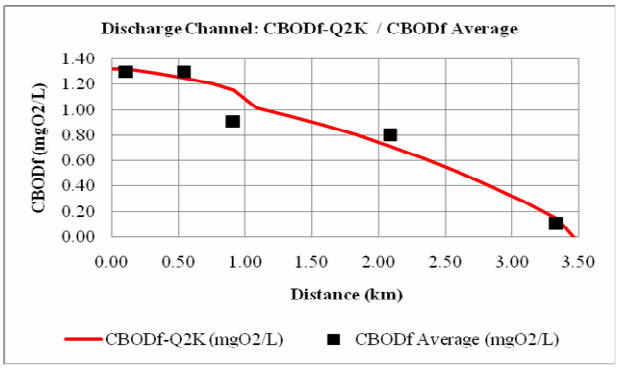

Figure 5a. CBODf on the Discharge Channel

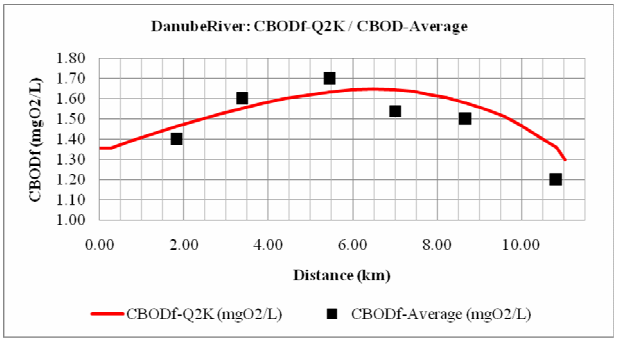

Figure 5b. CBODf on the Danube River

The concentrations of NH_4-N in the Danube River are genelally higher by 40% than in the Channel. The WWTP discharges increased NH_4-N concentrations in water. Both measured and simulated data of NH_4-N had decreasing trends in the direction of the flow on the two branches (Fig.6a and Fig.6b).

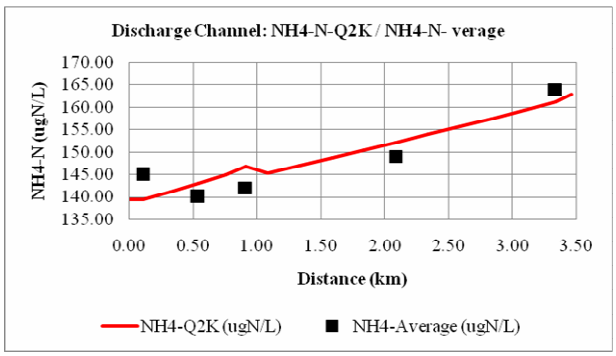

Figure 6a. NH_4-N on the Discharge Channel

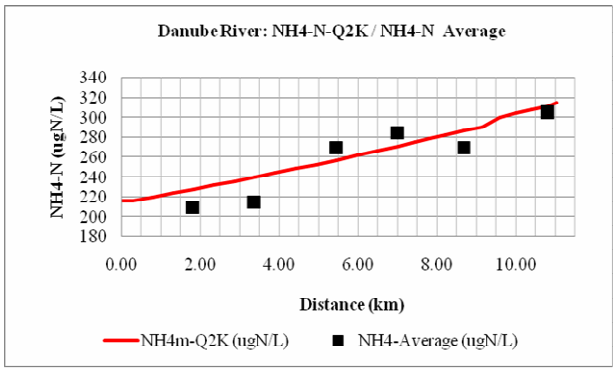

Figure 6b. NH_4-N on the Danube River

The concentrations of NO_3-N had higher values of about three times in The Danube River water than in Discharge Channel. The NO_3-N concentrations values in the Channel water were constantly increased by the WWTP discharges. The simulated values shoed a dilution effect of the NO_3-N concentration in the mixing area of the Channel water with the river (Fig.7a and Fig.7b).

Organic Phosphorus (Po) concentrations decreased along the flow on both water branches. The WWTP station added more Po in the Channel water. It was observed the same dilution effect of Po concentration too, in the mixing zone of the two main water fluxes (Fig.8a and Fig.8b).

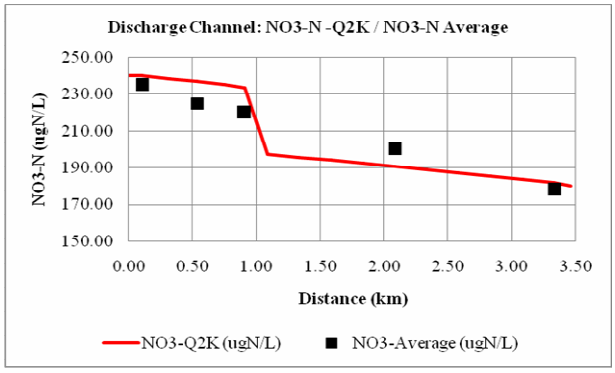

Figure 7a. NO_3-N on the Discharge Channel

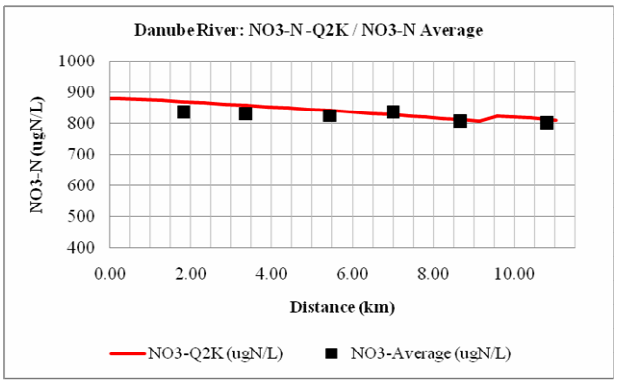

Figure 7b. NO_3-N on the Danube River

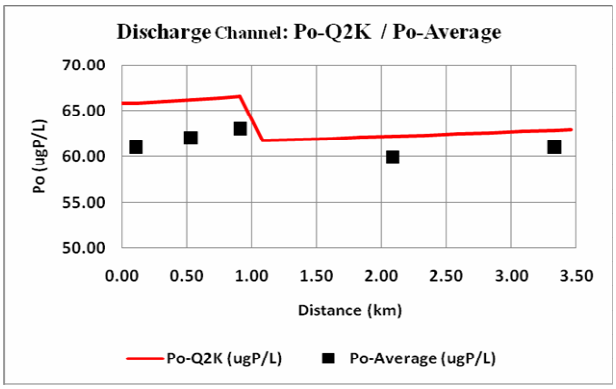

Figure 8a. Po on the Discharge Channel

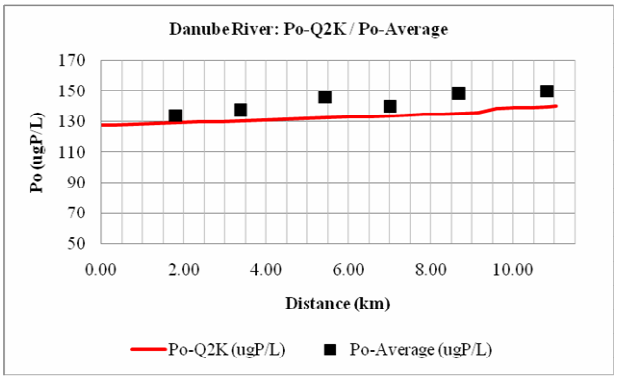

Figure 8b. Po on the Danube River

Phytoplankton distributions indicated decreasing trends on both water branches, but the concentration values in the Discharge Channel were about 5 times lower than in the river, due to the high water velocity in

the Channel. There were important differences between QUAL2K simulated values and measured whose causes could not be indentified (Fig.9a and Fig.9b). Future simulations and calibration have to be performed to study the fidelity of phytoplankton model used by QUAL2K software.

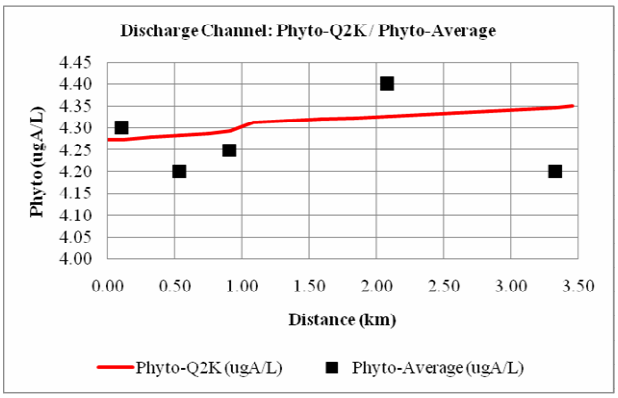

Figure 9a. Phytoplankton on the Discharge Channel

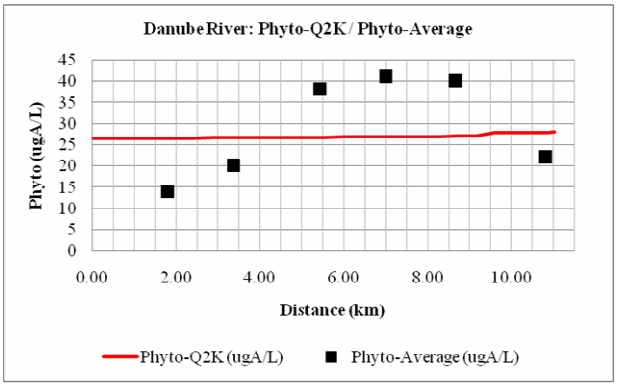

Figure 9b. Phytoplankton on the Danube River

Bottom Algae parameters indicated the highest concentration values in the Discharge Channel, downstream the WWTP Cernavoda, where the temperature, water velocity and nutrients were favourable factors for algal growth. The algal model of QUAL2K shoed a good similarity with the real data for both low and high concentration and various conditions of temperature and flow (Fig.10a and Fig.10b).

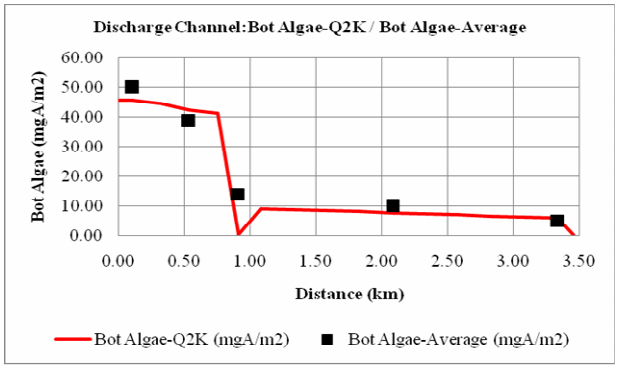

Figure 10a. Bottom algae on the Discharge Channel

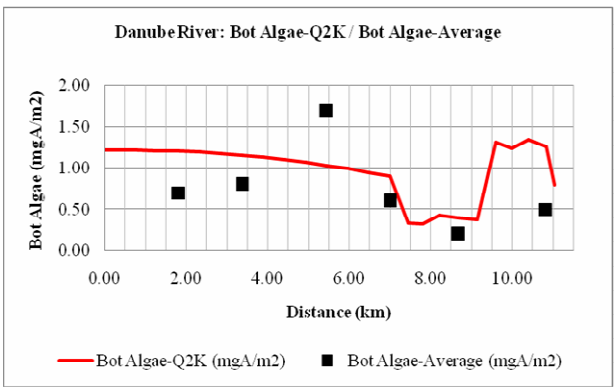

Figure 10b. Bottom algae on the Danube River

The temperature of the water is an important parameter in every aquatic ecosystem and for this reason the sampled or simulated data have to be very accurate. But for huge volumes of flowing water it would be necessary spatial dynamic distributions of the temperature. QUAL2K being a steady-state one-dimensional model it offers widely mediated temperature data. In the studied aquatic area the model simulated temperature parameters with good accuracy, on both Discharge Channel and Danube River (Fig.11a and Fig.11b). But the model cannot predict values of temperature in the mixing area of the two water fluxes.

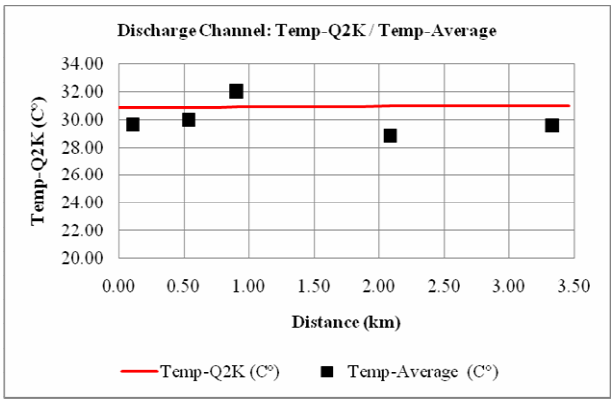

Figure 11a. Temperature on the Discharge Channel

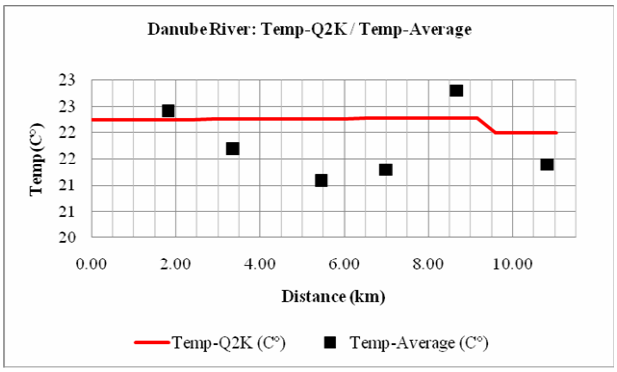

Figure 11b. Temperature on the Danube River

5. CONCLUSIONS

A stream water quality model, QUAL2K, was calibrated and validated for the aquatic area around Cernavoda City at the confluence between the Danube

River and the Discharge Channel of the water passing through the cooling system of NPP Cernavoda. Sampling data were collected in summer 2014 and used for calibration and evaluation the model. The simulated results correlated with the measured data quite well. The goals of this study were the calibration of QUAL2K model and the qualitatively and quantitatively evaluation of the similarity and accuracy of the predicted data. Also collected data revealed the main processes involved in aquatic pollution of the Danube River due to the warm water from the NPP Cernavoda and discharged water by the WWTP. For some parameters the models predicted very accurate values and highlighted fine processes which hardly could be detected only by sampling measurements. For other parameters the model predictions had not the necessary accuracy, but the errors could be generated by calibration details, or insufficient real data from the aquatic environment.

QUAL2K quality water model represents a good evaluation tool for aquatic environments but it has to be adapted and prepared for specific conditions, the accuracy of site data and of the calibrations trials being the measure of the similarity of the predicted information.

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SEARCH FOR OPTIMAL SOLUTIONS IN DESIGNINGELECTRIC VESSELS' PROPULSION COMPLEXES

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ABSTRACT

It was proposed to evaluate the quality of design of electric ships' propelling plants, first of all, by vessel's indices as its senior system. For electric ships these are the parameters characterizing their maneuverability. Therefore, a propelling electric plant is considered within an indivisible ship's propulsion complex including the power plant, propellers, rudder and ship's hull. Basic quality indices of maneuverability were determined. Parameters of electric ships' propulsion complexes influencing these indices were found and the ways of their calculation were given. The degrees of impact of the complex's parameters on maneuvering characteristics were assessed and relevant parameters were identified. At the first stage of optimization calculations, the object functions include vessel's quality indices as the senior system. At the second stage, there's a specification of these parameters by power plant's indices as the junior system. The method of parametric optimization of electric propulsion plants was developed. The optimal parameters were received. The results of parametric optimization are illustrated by a definite ship. Comparative analysis showed that implemented optimization resulted in increased efficiency of the complex in full accordance with the built object function. It was confirmed that a system approach to the design of a propelling plant and the correct prioritization of quality indices improves electric ships' operational efficiency ensuring at the same time satisfactory conditions of transient processes in a ship's power plant.

Keywords: *Electric ships' propulsion complexes, system approach, parametric optimization.*

1. THE URGENCY OF THE PROBLEM

Recent decades have shown a growing interest in the use of electric motion on modern ships. Traditionally advantageous areas of its application have been and remain ships of technical and auxiliary fleet, fishing vessels, ferries, ice navigation, research vessels, and others. Since the 90's passenger, cruise and naval vessels have been a promising option of propellers' electric drive.

Electric vessels' high maneuverability is one of the main qualities predetermining the cause of such a high interest in the use of modern systems of electric motion on ships and warships. Maneuvering modes are one of the main modes for the given ships. Therefore, special attention is given to reliability and safety performance of maneuvering operations.

The results of comparative analysis show that electric vessels' maneuvering characteristics are significantly better than those of ships with other types of power plants (PP). A reverse process is long and lasts one or two minutes for most ships having power plants with direct transmission of heat engines' torque to the propellers. The duration of propeller motors' (PM) reverse is seldom more than 15 - 20 seconds. The reverse procedure of propeller motors is a lot easier than reversing of internal combustion engines. Electric vessels have a better turning ability. Therefore, power plants with electric motion provide higher reliability and safety of performing maneuvering operations.

To create modern, highly maneuvering and reliable electric vessels it is necessary to have calculation methods of their maneuvering regimes and also search methods of power plants' optimal parameters. The solution to these problems can only be based on the system principle. Accordingly, comparison of the quality of power plants' design should be carried out in the first place by the vessel's criteria [1]. Consequently, a power plant must be considered in unity with all the components of the electric ship's propulsion complex.

Electric ship's power plant is a complex consisting of prime movers, electric power generators, electric power transformers, propeller motors, exciters of electric machines. The components of the complex may have several forms. The result is a large number of possible layout options of propulsion systems. All this creates significant problems in choosing PP, in the comparative evaluation of advantages and disadvantages of one or another system. To make a correct decision it is necessary to have unified methods of analysis, a common approach to the analysis of the various options and development of rational solutions.

2. BASIC MATERIAL

In general, a block diagram of the electric ship's complex can be represented in Figure 1 and includes: *D* – prime movers (diesel, steam or gas turbines); *G* – electric power sources (electric machines' generators of direct current or alternating current, direct energy transformers); *SE* – electric converters (uncontrolled or controlled rectifiers, voltage or current inverters, direct-frequency converters, frequency inverters); *M* – propulsion motors (*DC*, asynchronous, synchronous with the frequency control, valve motors); *P* – propellers; *CS* – control system; *DR* – prime movers' regulators; *GE* and *ME* – excitatory devices of generators and propulsion motors; *H* – the steering wheel; electric ship's hull. Control system also includes: prime movers' power sensors P_D and speed sensors ω_D; generators' voltage

sensors U_G and current sensors I_G; propeller motors' voltage sensors U_M, current sensors I_M, torque sensors M_M and rotation speed sensors ω.

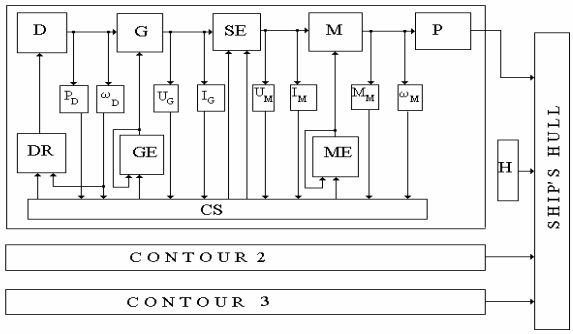

Figure 1 Block diagram of electric ship's complex

Mathematical model of transient modes of operation of all its components was developed on the basis of the above block diagram. It allows to calculate current values of basic regime indices of the complex. The obtained system of equations is extremely complex and cumbersome. Hundreds of parameters affect transient operation modes of the complex. In such a situation, on the one hand, it is absolutely impossible to solve problems of analyzing electric vessel's behavior (even at the present level of computer technology), on the other hand, the results of such investigations can't be extrapolated on other ships. It reduces their scientific value.

We will use the notion of dynamically equivalent complex [2] to reduce the number of parameters and to give common features to the results of the analysis. According to it, the system of equations is transformed to the dimensionless form and dynamic similarity criteria – propulsion systems' dimensionless parameters are singled out in it. As a result:

– the number of parameters (systems' dynamic similarity criteria) reduces by 5-6 times;

– ample opportunities of summarizing the results of the research appear here: systems with equal values of the parameters will have the same laws of variation (in relative units) of respective regime indices; the obtained results will be applicable to all electric vessels of this class, etc.

Mathematical model of transient regimes (in relative units) is presented in [3]. Relative values of regime indices are given here as a ratio of current values to basic ones. The values corresponding to the propulsion complex's operation at a nominal steady regime are taken here as basic ones. This model gives us an opportunity to asses the behavior of each component of the complex with any layout variant of its propulsion plant. The developed calculation method enables us to find current values of regime indices:

- prime movers' angular rotation velocity ω_D, torque M_D, and power P_D;

– generators' voltage U_G and current I_G;

– propulsion motors' (*PM*) voltage U_M and current I_M;

– propulsion motors' torque M_M and angular rotation velocity ω_M;

– propellers' moment of resistance M_P and thrust P_P;

– ship's movement parameters in related with the ship coordinate system *XYZ* (velocity components v_X and v_Y along the longitudinal *X* and transverse *Y* axis of the ship's hull; angular rotation velocity Ω_X around the vertical axis *Z*), and in unrelated coordinate system $X_1Y_1Z_1$ (velocity components v_{X1} and v_{Y1}, speed angle φ_c, course angle ψ_c and distance traveled *X*1, *Y*1).

As an example, Figure 2 gives the calculation results of current values of regime indices of electric ship's propulsion complex with frequency-controlled propulsion motors during maneuvers: acceleration – the reverse from front motion to back motion – the reverse from back motion to front motion.

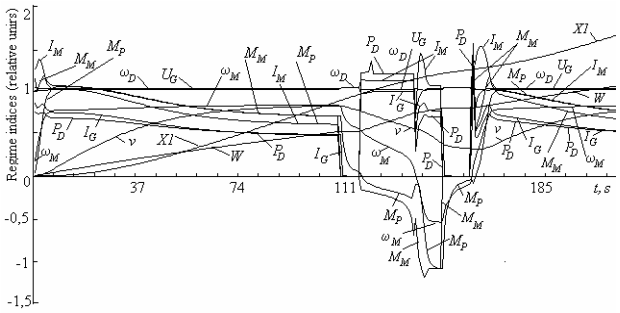

Figure 2 The laws of changes of regime indices: acceleration ($0 \le t \le 111$) – reverse from front motion to back motion ($111 \le t \le 148$) – reverse from back motion to front motion ($t > 148$)

In Figure 2 to the relative unit on the ordinate axis correspond: $\omega_D = 78{,}5\ s^{-1}$; $U_G = 400$ V; $I_M = 1206$ A; $M_P = 10840$ Nм; $v = 7$ м/s; $W = 30$ r.v. (Relative values); $P_D = 1100$ кW; $I_G = 1800$ A; $M_M = 10840$ Nм; $\omega_M = 25{,}12\ s^{-1}$; $X1 = 517$ *m*.

The ability to calculate the current values of regime indices of propulsion complex is certainly of interest. However, in the initial stages of electric vessels' design separate indices which help us to assess the quality of maneuvre operation are of much greater interest. The calculation method allows to estimate these indices.

They include:

– duration of maneuvre operation *T*;

– fuel consumption to perform the maneuver *W*;

– deviation of prime movers' angular rotation velocity;

– prime movers' maximum power increase;

– bursts of generators' current during acceleration $(I_G)_{AM}$ and reverse $(I_G)_{RM}$;

– steady values of generator's current during acceleration $(I_G)_{AS}$ and reverse $(I_G)_{RS}$;

– voltage overfall at the generators' output ΔU_G;

– duration of acceleration $(T_{PM})_A$ and reverse $(T_{PM})_R$ of propulsion motors and propellers;

– propulsion motors' current spikes during acceleration $(I_{PM})_{AM}$ and reverse $(I_{PM})_{RM}$;

– propulsion motors' spikes of torque during acceleration $(M_{PM})_{AM}$ and reverse $(M_{PM})_{RM}$;

– propulsion motors' steady values of torque during acceleration $(M_{PM})_{AM}$ and reverse $(M_{PM})_{RM}$;

– propulsion motors' and propellers' steady values of the angular rotation velocity during acceleration $(\omega_M)_{AS}$ and reverse $(\omega_{PM})_{RS}$;

– duration of transient processes in power plant during acceleration $(T_{EPP})_{AS}$ and reverse $(T_{EPP})_{RS}$;

– shp's maximum speed by the end of the acceleration v_{MAX};

– duration of acceleration of the propulsion complex to the given target speed $(T)_{V=VT}$;

– distance traveled by the ship at the end of the maneuver $(X1)_A$ or $(X1)_R$;

– prime movers' changes in power when the electric vessel goes out to a steady circulation;

– propulsion motors' changes in the stator current of external $(\Delta I_{PM})_1$ and internal $(\Delta I_{PM})_2$ contours;

– propulsion motors' changes in the torque of external $(\Delta M_{PM})_1$ and internal $(\Delta M_{PM})_2$ contours;

– changes in the angular rotation velocity of propulsion motors and propellers of external $(\Delta\omega_{PM})_1$ and internal $(\Delta\omega_{PM})_2$ contours;

– reducing the vessel's speed at a steady circulation $(\Delta v)_{CIR} = v_{CIR}/v_{BEG}$;

– vessel's angular velocity of rotation Ω_Z at a steady circulation Ω_{CIR};

– circulation diameter D_{CIR} and its tactical diameter D_{CIRT};

– vessel's pushing L_1 and its direct offset L_2;

– angle of ship's course after a given period of time ψ_{DEF};

– duration of the complete revolution T_{CIR};

– duration of the evolutionary period of maneuver T_{CIREV};

– consumption of fuel for the performance of the ship's complete revolution in circulation W_{CIR}.

Here, index "1" corresponds to the outer (left) power circuits and "2" – to the inner (right) power circuits in relation to the circulation center, and index "the beginning" to the initial (before the maneuver) value of the respective quality index.

Taken together, these indices cover all major components of the electric ship's power plant and the whole electric ship in general, and are sufficient to assess the maneuvering performance of propulsion complexes.

Criteria of dynamic similarity (propulsive systems' dimensionless parameters) were obtained in the process of transforming this model to dimensionless form. It is these parameters that influence the laws of changes of regime indices in time. The number of parameters is great. It complicates the analysis of their influence on the indices of the quality of maneuvering and complicates complex's parametric optimization.

It is known that only a limited number of parameters – no more than 8-10 – can have a significant impact on quality indices. It is expedient to identify these parameters. It is these parameters that are to be optimized. Scatter in the other parameters has no significant effect on the studied quality index and their values should be taken as non-variable.

It is proposed to solve this problem by means of sift experiments. To do this, we use the method of random balance, allowing to analyze the degree of influence of all parameters and the effects of parameter interaction. Quantitative assessment of the degree of influence is performed with analytical models of the form

$$J = \sum_{i=0}^{k} b_i q_i , \qquad (1)$$

where b_i – model coefficients reflecting the influence of the parameters (for i = 0, 1, ..., l) and the effects of the interaction of parameters (for $i = \overline{l+1, k}$); q_i – the parameters and the effects of their interactions.

Studies conducted with the involvement of dispersion and regression analyses allowed to reveal important parameters and the effects of parameter interactions for each quality index. The results are presented in the analytical (dependences of indices on parameters and effects) and graphical forms (histograms with contributions in percentage).

As an example, below are shown contributions of significant parameters and interaction effects into such an important index as electric ship's duration of acceleration T_{acc} (analytical dependence (2) and graphical dependence – Figure 3).

$$T_{acc} = 22{,}2 - 3{,}09N_X - 1{,}23C_{M16} - 1{,}10N_M + 0{,}81N_XC_{M21} + 0{,}82C_{M23} + 0{,}58N_N N_X. \qquad (2)$$

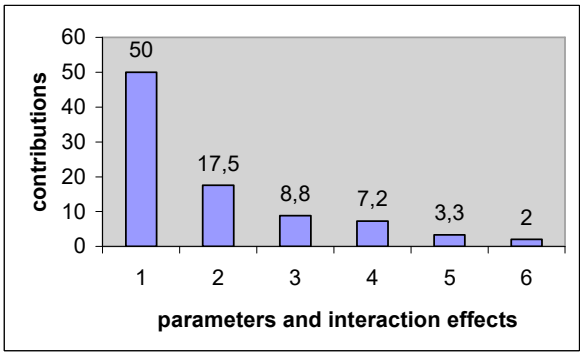

Figure 3 Contributions of parameters and interaction effects into index T_{acc}

(1 – N_X; 2 – C_{M36}; 3 – N_M; 4 – $C_{M23}N_X$; 5 – C_{M23}; 6 – $N_M N_X$)

Identification of relevant parameters and interaction effects allows hundreds of times to reduce the amount of numerical experiments in further research. The calculation method of the obtained parameters N_X, C_{M36}, N_M, C_{M23}, N_X, and C_{M23} will be shown below (not to break the logical construction of the article).

A wide variety of possible layout options for electric power plant (*PP*) causes serious difficulties in the selection of its composition, determining the optimal parameters of the constituent units. When designing such complicated hierarchical systems, as ship's propulsion complexes, a system approach is needed. It involves such a construction of a junior system, which will be most appropriate to the senior system (junior system serves to ensure senior system's operation). Therefore, a comparative evaluation of the quality of design of

electric ship's power plant should be carried out, first of all, according to the criteria of the vessel as the senior system. Otherwise a well-designed power plant may turn out ineffective for the vessel itself.

This paper considers some aspects of designing optimal power plants which could provide electric vessels' high maneuvering properties. The basis of solving optimization tasks is the above-mentioned calculation method of current values of regime indices and quality indices of maneuverability.

Any practical optimization problem usually requires individual approach and its informal methods of solution. This fully applies to the design of such complicated electromechanical systems as electric vessels' propulsion complexes. The formal classical methods of solution, as shown by the conducted investigation, either don't "work" here, or lead to prolonged time-consuming computing procedures. Special optimization methods taking into account the nature of the object functions and providing minimum amount of calculations are necessary.

In [4] a special method of optimization with respect to the considered class of problems was developed In its statement, the problems under consideration are in the area of nonlinear programming and consist in finding the extrema of multimodal object functions $f(\boldsymbol{x})$ under given constraints $g_j(\boldsymbol{x})$ in the form of inequalities

$$\left.\begin{array}{l} f(x), \quad x \in E^n; \\ g(x) \geq 0, \ j = 1, ..., p, \end{array}\right\}, \tag{3}$$

where $\boldsymbol{E^n}$ - admissible domain of n -dimensional space.

The optimal solution would be a pair of $\boldsymbol{x}_*$ and $f(\boldsymbol{x}_*)$, consisting of the optimal point $\boldsymbol{x}_* = [x_{1*}, x_{2*}, ..., x_{n*}]$ and the corresponding value of the object function $f(\boldsymbol{x}_*)$

$$\left.\begin{array}{l} x_* = [x_{1*}, x_{2*}, ..., x_{n*}]; \\ f_* = f(x_*). \end{array}\right\}. \tag{4}$$

The character of object functions has the fundamental impact on the design of optimization method. As shown by numerous calculations, object functions $f(\boldsymbol{x}_*)$ are multiextremal with an unknown number of local optima. Therefore, the algorithms of search for optimal solutions were based on the principle of global optimization. The basis of the global optimization algorithm is the method of global random search – random multistart. To prevent repeated descent to local minimum points in the global optimization algorithm we introduced a combination of a passive coating method – the method of random network – with a modified method of tunneling algorithm.

Object functions have a pronounced "ravine" nature. The search algorithm of intermediate local minima (global optimization internal procedures) was made on the basis of a combination of methods of local slopes and techniques of the ravine search.

Methods that do not use derivatives should be applied to find local minima. Methods of Powell and Nelder-Mead turned out to be effective for solving this class of problems.

The used methods combined with the methods of the penalty function allowed to transform the problem of nonlinear programming with constraints to an equivalent sequence of tasks without any restrictions.

Comprehensive assessment of quality of design of ships' power plants involves a multi-criteria optimization. In this case, the object function $J = \sum_j m_j J_j$ of optimization processes must include the main quality indices of maneuvers J_j with their contributions m_j. It is possible to facilitate the optimization problem without significantly worsening the results of its solution by dividing quality indices into two groups:

a) senior, which includes indices characterizing the ship, electric vessels' maneuvering properties, their efficiency, etc.;
b) junior, characterizing maneuvering properties of power plant, its component parts, the quality of the flow of transient processes in the power components of *PP*.

In accordance with the system approach, the optimization is carried out first by the senior group indices, and then, adhering to the principles of "non-worsening" (taking into account the specified tolerance), by the junior group indices. The criteria of the senior group should include the following: the duration of the maneuver – $T_{\min}$, fuel consumption for its implementation – $W_{\min}$, advance of the vessel – $X1_{\min}$. The criteria of the junior group should include the following: the duration of the transient processes in *PP* – T_{PPrev}, maximum power of prime movers – $P_{D\max}$, prime movers' deviation of rotation speed from the steady regime – $\Delta\omega_D$, electromagnetic losses in the propeller motors (*PM*) – A_{min}, duration of the propeller motors' reverse – T_{PMrev}.

We will consider the solution to similar problems with regard to the prospective electric ships with frequency-controlled propulsion motors. Preliminary studies conducted by random balance, allowed to identify relevant parameters and the effects of parameter interaction for each quality index of the maneuver operation. Their contributions into the studied quality indices are shown in Table 1.

Table 1. Contributions of relevant parameters into the maneuvering quality indices

Quality indices	Dimensionless parameters							
$T_{\min}$	Parameter	N_X	C_{M16}	C_{M20}	C_{M18}	C_{M23}	C_{G7}	C_{M17}
	Contribution in %	38,4	28,7	12,9	5,9	3,3	2,5	4,9
$W_{\min}$	Parameter	N_X	C_{M23}	C_{M17}	C_{M20}	C_{M16}	C_{M21}	C_{M18}
	Contribution in %	26,6	20,8	16,5	11,3	10,7	1,7	6,3
$X1_{\min}$	Parameter	C_{M16}	C_{M23}	N_X	N_M	-	C_{M20}	-
	Contribution in %	26,3	19,3	29	3,5	-	21,5	-
$\Delta\omega_D$	Parameter	N_D	c_{DP}	C_{G7}	C_{G8}	C_{M16}	C_{G10}	-

	Contribution in %	26	25,4	14	13,3	13,8	6,3	-
$P_{D\max}$	Parameter	C_{M16}	C_{G7}	C_{M23}	C_{M17}	C_{M20}	-	-
	Contribution in %	27,6	20,5	17,8	15,3	13,6	-	-
T_{PMrev}	Parameter	C_{M16}	C_{G7}	C_{M20}	N_X	C_{G8}	C_{M38}	-
	Contribution in %	22,5	29,8	17,5	14,7	10,6	9,8	-
T_{PPrev}	Parameter	$k2$	C_{M16}	N_X	N_D	C_{G7}	C_{M17}	C_{M20}
	Contribution in %	34,4	18,7	13,4	9,3	7,4	7,4	7,4

These parameters are calculated by the relationships:

$$C_{G7} = \frac{K_{GE} w_{GV}}{E_{G0}} \omega_{D0} I_{GV0}; \quad C_{G8} = \frac{K_{GE} \omega_{D0}}{E_{G0}} \frac{m_G \sqrt{2}}{\pi} \frac{w_{G1} k_{GB}}{p_G} I_{G0};$$

$$C_{G10} = \frac{U_{G0}}{E_{G0}}; \quad C_{M18} = \frac{c_M^2}{r_{2M}'^2} \alpha_0^2; \quad C_{M23} = 2 \frac{r_{1M}}{r_{2M}'} \alpha_0;$$

$$C_{M16} = \frac{\beta_{M0}}{r_M'^2} \left[\left(b_M^2 + c_M^2 \alpha_0^2\right) + \left(d_M^2 + e_M^2 \alpha_0^2\right) \frac{r_{2M}'^2}{\beta_{M0}^2} + 2 r_{1M} \alpha_0 \frac{r_{2M}'}{\beta_{M0}} \right];$$

$$C_{M17} = \frac{b_M^2}{\left(r_{2M}'\right)^2}; \quad C_{M20} = \frac{\omega_{M0}}{\omega_{1MH}}; \quad C_{M21} = d_M^2;$$

$$N_X = \frac{L P_{e0}}{(m + \lambda_{11}) v_0^2}, \quad N_M = \frac{M_{M0} L}{J_M \omega_{M0} v_0}; \quad N_D = \frac{M_{D0} L}{J_D \omega_{D0} v_0},$$

where: ω_{D0} – prime mover's angular velocity of rotation; I_{GV0} – synchronous generator's exciting current; U_{G0} и I_{G0} – generator's voltage and current; K_{GE} , m_G, w_{G1}, k_{GB}, p_G и w_{GV} – generator's structural parameters; E_{G0} – generator's longitudinal component of the resultant electromotive force; ω_{M0} и $\omega_{1Mн}$ – angular velocities of rotation of the motor and the magnetic field of the stator at the nominal frequency; β_{M0} – absolute slip of *M's* rotor; α_0 – relative frequency of *M's* voltage; r_{1M} и r_{2M}' – active stator resistance and reduced active resistance of rotor of *M's*; b_M, c_M, d_M, e_M – constant coefficients of frequency-controlled asynchronous motor; m и λ_{11} – vessel's weight and associated water masses along its longitudinal axis; P_{e0} – a useful total thrust of propellers; L – vessel's length; M_{D0}, M_{M0} – torque of the prime mover and M; J_D, J_M – moments of inertia of prime mover and propeller motor. (index "0" refers to the basic operation mode corresponding to the movement of the vessel with a nominal engine power);

– c_{DP} – statism of regulatory characteristics of prime movers;

– $k2$ – coefficient characterizing the rate of voltage rise of propulsion motors during braking.

In the process of parametric optimization the following restrictions ensuring power plant's normal operation superimposed on its regime indices:

– power of prime movers – $P_{D\max} \leq 1$;

– maximum deviation of the angular rotation velocity of prime movers $\Delta\omega_{D\max} \leq 0{,}04$;

– voltage fluctuations at the output of the main generators $\Delta U_{G\max} \leq 0{,}1$;

– maximum load of current of main generators – $I_{G\max} \leq 2$;

– maximum load of current of propeller motors – $I_{M\max} \leq 2$;

– maximum load of torque of propeller motors – $M_{M\max} \leq 1$;

– maximum allowable input voltage of propeller motors – $U_{M\max} \leq 1$.

When optimizing by the quality indices of the senior group the maneuver duration T_{min} and fuel consumption for its implementation W_{min} have been selected as optimality criteria. The search for optimal parameters was carried out by a multicriteria object function

$$J_{TW} = m_T T + m_W W,$$

m_T и m_W – weight coefficients of respective indices.

It is possible to clarify the values of optimized parameters by the indices of the junior group. This optimization carried out with regard for "non worsening" of the senior group indices with specified tolerance makes it possible, on the one hand, to improve the indices of the power plant's operation, on the other, not to worsen essentially the quality indices of the senior group.

The final optimal values of propulsion complexes' parameters obtained as a result of gradual parametric optimization are shown in Table 2.

Table 2. Optimal values of the parameters of electric vessels' propulsion complexes.

Parameters of the complex	Change ranges	Optimal values
N_X	0,06 – 0,20	0,2
C_{M23}	0,8 – 1,6	1,6
C_{M16}	4 – 14	8,1
C_{M20}	0,6 – 0,9	0,9
C_{M18}	1 – 9	5
C_{M17}	0,2 – 0,8	0,5
C_{G7}	1,5 – 1,9	1,81
C_{G8}	0,86 – 1,35	1,1
N_D	1 – 6	3,5
c_{DR}	1,035 – 1,065	1,04
C_{M22}	1,05 – 1,21	1,1

The results of the parametric optimization are illustrated by a definite electric ship (the port icebreaker with displacement of 2050 tons) "Electric ship". The numerical values of this vessel's parameters are shown in column "Electric ship" Table 3. Optimization by senior group indices was performed at a ratio of weight coefficients $m_T = 0$ и $m_W = 1$. Optimization by the junior group indices was curried out by multicriteria object function $J_{TP\omega} = m_T T_{\text{rev}} + m_P P_D + m_\omega \omega_D$, at a ratio of weight coefficients $m_\omega = 0{,}75$, $m_P = 0{,}25$, $m_T = 0$. The optimal parameter values are shown in respective column of Table 3.

Table 3. Optimized parameters of propulsion complex "Electric ship"

Parameters	Parameter values			Parameters	Parameter values	
	"Electric ship"	Optimal			"Electric ship"	Optimal
N_D	1,937	3,5		C_{M17}	1,016	0,5
c_{DR}	1,04	1,04		C_{M18}	40,21	5
C_{G7}	1,45	1,81		C_{M20}	0,895	0,9
C_{G8}	0,608	1,1		C_{M22}	1,12	1,1
N_X	0,132	0,2		C_{M23}	0,233	1,6
C_{M16}	14,127	8,1		C_{M24}	12	5,55

The behavior of this type of electric ship and its optimized version when performing two alternating maneuvers: "electric ship's acceleration" and "electrical propulsion plants' reverse" was illustrated, as an example in Figure 4. It shows current values of the main regime indices for the real (Figure 4a) and optimized vessel (Figure 4b).

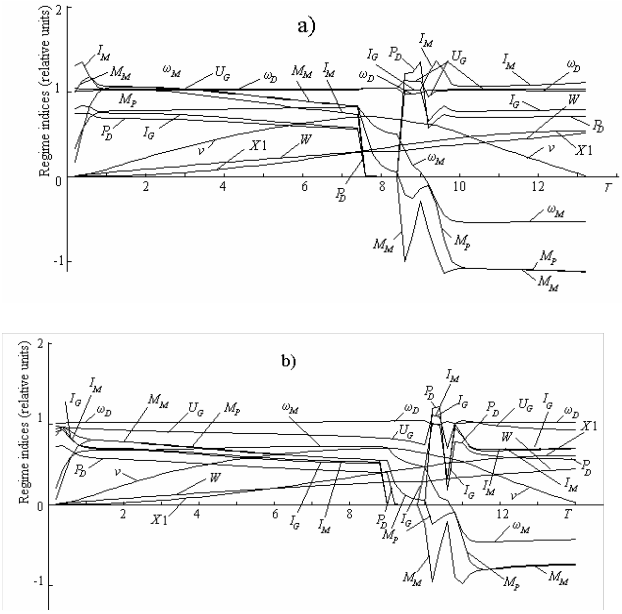

Figure 4 Current values of electric ship's regime indices

A comparison shows that transient processes proceed "softer" in a complex with optimally designed power plant. The values of the main quality indices (which were the basis of object functions) for "electric ship" and its optimized version are shown in Table 4. The results of the assessments of optimization efficiency are given here.

Table 4. Maneuvering quality indices

Quality indices	W	T	$\Delta\omega_D$	$P_{D\max}$	T_{PMrev}
"Electric ship"	25,35	13,2	0,0700	1,355	1,60
Optimized complex	22,12	14	0,0466	1,217	1,65
Optimization efficiency	12,7 %	-6,0 %	33,4 %	10,2 %	-3,1 %

3. CONCLUSIONS.

The results of the conducted research clearly show the effectiveness of a system approach to parametric optimization of electric vessels' propulsion complexes. Solution to the problem is characterized by common theoretical foundations, methods of analysis and obtained results. The developed methods contribute to the construction of a consecutive analysis of transient operation modes of electrical propulsion plants as part of a ship's propulsion complex and synthesis of such complexes with predicted maneuvering characteristics.

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SECTION III
ELECTRONICS, ELECTRONICAL ENGINEERING AND COMPUTER SCIENCE

AN APPROACH TO ASSESS THE OPERATIONAL POTENTIAL OF TECHNICAL EQUIPMENTS. EXPERTONS AND ENTROPY

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ABSTRACT

The aim of this paper is to fundament methods to evaluate, from a time and functional point of view, technical equipments that are described by exploitation conditions like majority redundant „*k* out of *k+1*". [1],[2]. The purpose is that to identify a certain equipment towards which the management could order preventive maintenance operations. Obviously, finding the optimal decisional solution involves having conclusive information obtained from the exploitation documents (statistical data, technical exploitation instructions, security rules, etc). This type of informations, related to operative behaviour on a certain, pre-established, time interval will be subject to an analysis performed by a group of experts. Their points of view – the assessments of the experts – are to be sequenced on a scale, having a certain number of levels, linear or non-linear (non-linear is preferable)for a greater accuracy of the conclusions of this type of analysis. It is conspicuos that non-objective assessements, generated mainly by the behaviour of the group of experts, will be removed when the findings will be revised using statistical and mathematical tools, suitable for this type of analysis.

Keywords: *Assessment, linear (non-linear) scale, experton, fuzzy operators, performance function, entropy.*

1. INTRODUCTION

Let be $[A_j^{inf}; A_j^{sup}]$ cu $j = \overline{1;m}$ be the inferior/superior limits of some assessements proposed by a group of experts, related to the functionality of a technical system and given in a non-numerical (linguistic), and $[a_j^{inf}; a_j^{sup}]$, the intervals associated to these assessments, acording to a ranking scale.

Table 1. The scale with seven levels linearly arranged [7]

k	Semantics	Linear version	
		α_k^l	$\Delta^l\alpha_k$
1	Unsatisfactory	0	0
2	Almost unsatisfactory	0,167	0,167
3	Less satisfactory	0,333	0,167
4	Satisfactory	0,5	0,167
5	Good	0,667	0,167
6	Almost very good	0,833	0,167
7	Very good	1	0,167

Figure 1 presents the graph of this scale where:

α_i – the level of the scale ,

n_i – the number of the level ,

$\Delta\alpha_i$ – represents the increment of the scale.

In the following, we propose a non-linear scale obtained from two parabolic convex-concave segments, both having the shape of a logistic function having point $M(\mathrm{m} = 4; \alpha = 0,5)$ as an inflection point. The logistic function is specific to the evolution of phenomena with a strong tendency to increase after a certain time defined by the inflection point of the graph of this function. It is recommended for research in engineering, economy, biology, etc. The y-coordinate of this function is of sigmoid type are obtained by using the following operators:

- concentrator (C) for levels α_2, α_3;
- dillator (D) for levels α_5, α_6 [6],[7].

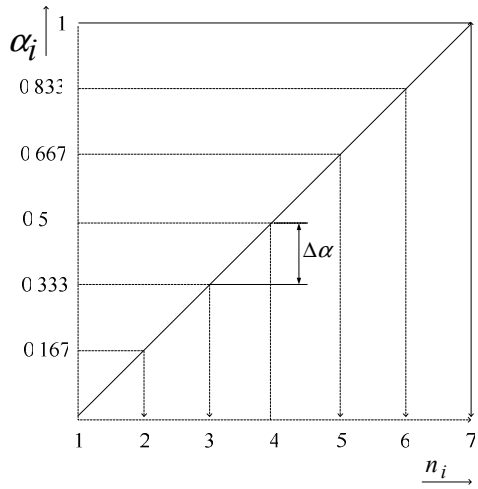

Figure 1 Seven-levels linear scale

$$\alpha_2^c, \alpha_3^c = \alpha_2^\varphi, \alpha_3^\varphi \; ; \qquad (1)$$

$$\alpha_5^D, \alpha_6^D = \alpha_5^{1/e}, \alpha_6^{1/e} \; ; \qquad (2)$$

where φ is the gold number from Fibonnacci string: $\varphi = \lim_{n\to\infty} \frac{a_n}{a_{n-1}} \Rightarrow \varphi \cong 1,618034$, a_n, a_{n-1} are consecutive numbers in Fibonnacci string [3].

Obviously, in the non-linear version of the scale (NL), the levels α_K^{NL} and the increment $\Delta\alpha_k^{NL}$ have values significant different compared to the linear scale such in the table two.

Table 2. The level and the step in the non-linear case

k	1	2	3	4	5	6	7
α_k^L	0	0,167	0,333	0,5	0,667	0,833	1
$\Delta\alpha_k^L$	0	0,167	0,167	0,167	0,167	0,167	0,167
α_k^{NL}	0	0,055	0,169	0,5	0,861	0,935	1
$\Delta\alpha_k^{NL}$	0	0,055	0,114	0,331	0,361	0,074	0,035

The graph of the seven-level, non-linear scale is given in Figure 2.

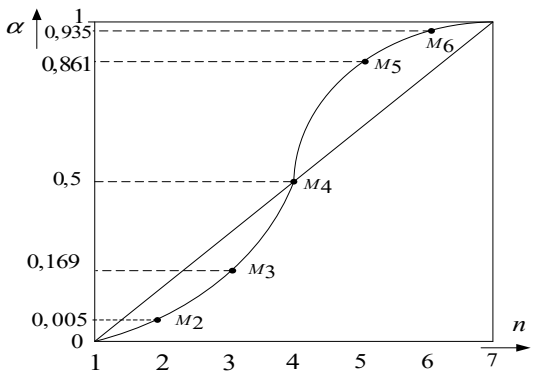

Figure2 The non-linear, seven-level scale

The concave parabolic segment is defined by points situated at a bigger distance to median reference line compared to the points that describe the inferior part is justified by phenomenological or managing reasons (forecasts, the study of reliability of equipments, etc). For example, if we consider the estimation of the reliability of a technical entity, to level five and six of the linear scale match $\alpha_5 = 0,667$ and $\alpha_6 = 0,883$ which do not meet the requirements imposed by the expert. It is neccessary that in this type of cases to associate values placed in the vicinity of a likelihood threshold as close as possible to the reality (the frequently cited value of the realiability is greater than 0.8).

2. A STATISTICAL ANALYSIS OF $\alpha = f(\mathrm{n})$ FUNCTION

The points of the graph of the non-linear scale $M_1(\mathrm{n}=1;\alpha_1=0), M_2(\mathrm{n}=2;\alpha_2=0,055)$, $M_3(\mathrm{n}=3;\alpha_3=0,169), M_4(\mathrm{n}=4;\alpha_4=0,5)$, $M_5(\mathrm{n}=5;\alpha_5=0,861), M_6(\mathrm{n}=6;\alpha_5=0,935)$ and $M_7(\mathrm{n}=7;\alpha_7=1)$ belong to a logistic function [8],[9] shapped by the relation:

$$\alpha = \frac{A}{1+B\times e^{-kn}}, \tag{4}$$

where n is the number of the level of the scale and A, B, k are the parameters of the function. Because the function is not symmetric when referenced to the $M_4(\mathrm{n}=4;\alpha_4=0,5)$ inflection point, we propose two distinct dependency relations as follows:

a) for the part of the graph defined by levels n∈ {2,4,6}

b) for the area of the graph corresponding to points M_3, M_4, M_5 having the x-coordinate n∈ {3;4;5}.

The parameters of these functions yield from the relations:

- case a)

$$(\frac{A}{\alpha_2}-1)(\frac{A}{\alpha_6}-1) = (\frac{A}{\alpha_4}-1)^2; \tag{5}$$

$$A = \frac{\frac{1}{\alpha_2}+\frac{1}{\alpha_6}-\frac{2}{\alpha_4}}{\frac{1}{\alpha_2\alpha_6}-\frac{1}{\alpha_4^2}}, \tag{6}$$

$$k = n^* \ln\frac{\frac{1}{\alpha_2}-1}{\frac{1}{\alpha_6}-1}, \tag{7}$$

where $n^* = 4$ (x-coordinate of the inflection point).

$$B = (\frac{A}{\alpha_n - 1})\mathrm{e}^{kn}. \tag{8}$$

where n∈ {2,4,6}.

When substituting calculation data we obtain: $\alpha_2 = 0,055; \alpha_4 = 0,5; \alpha_6 = 0,935$. The results are A=0.98742, k=1.428, B=295.

- case b)

$$(\frac{A}{\alpha_3}-1)(\frac{A}{\alpha_5}-1) = (\frac{A}{\alpha_4}-1)^2; \tag{9}$$

$$A = \frac{\frac{1}{\alpha_3}+\frac{1}{\alpha_5}-\frac{2}{\alpha_4}}{\frac{1}{\alpha_3\alpha_5}-\frac{1}{\alpha_4^2}}, \tag{10}$$

$$k = n^* \ln\frac{\frac{1}{\alpha_3}-1}{\frac{1}{\alpha_5}-1}, \tag{11}$$

$$B = (\frac{A}{n}-1)\mathrm{e}^{kn}, \tag{12}$$

where n∈ {3;4;5}.

Also, for these levels of the scale that match the values $\alpha_3 = 0,169; \alpha_4 = 0,5; \alpha_5 = 0,861$, we obtain the following values of the parameters: A=1,072, k=1,541, B=544. So, these logistic functions are :

$$\alpha = \frac{0,98742}{1+295e^{-1,428n}}; \tag{13}$$

$$\alpha = \frac{1,72}{1+544e^{-1,541n}}. \tag{14}$$

Another version of this function, defined by the average values of these parameters, would make no sense because – as above mentioned – the graph obtained from the two parabolic segments (concave - convex) are not symmetrical when referenced to the inflection point, $n_4(\alpha = 0,5)$.

Also, the limited statistical volume of only four values of level $\alpha_2, \alpha_3, \alpha_5, \alpha_6$ (the another level being imposed $\alpha_1 = 0, \alpha_4 = 0,5, \alpha_7 = 1,$) cannot confirm the achievement of a pertinent unique dependency, regarding the operational status of a technical equipment.

3. THE EXPERTON

This concept represents a statistical table having two columns and a number of lines equal to the number of the levels of the scale – in this case, seven. Each line represents the relative cumulated frequency of the corresponding level of the scale [10].

$$f_{rc}(\alpha_r) = \left[f_{rc}^{\inf}(\alpha_k); f_{rc}^{\sup}(\alpha_k) \right], \quad (15)$$

where $f_{rc}^{\inf/\sup}(\alpha)$ is the relative cumulated frequency given as an interval, with the inferior/superior limits associated to α_k level.

The defining size of an experton is the mathematical expectation, given also as an interval:

-for the linear scale,

$$E(Ex(Z)) = \left[E^{\inf}(Ex(Z)); E^{\sup}(Ex(Z)) \right], \quad (16)$$

where $E_x(Z)$ is the experton of one Z size.

For the liniar scale,

$$E^{\inf/\sup}(Ex(Z)) = \frac{1}{N-1} \sum_k f_{rc}^{\inf/\sup}(\alpha_k). \quad (17)$$

In the relation (17) N is the number of levels of the scale (N=7).

- for the non-linear scale,

$$E^{\inf/\sup}(Ex(Z)) = \sum_k f_{rc}^{\inf/\sup}(\alpha_k) \times \Delta\alpha_k. \quad (18)$$

In the case of linear scales, the mathematical expectation of an experton is is equal to the average of the intervals associated to the group of experts:

$$E(Ex(Z)) = m(Z); \quad (19)$$

where

$$m(Z) = \left[\frac{\sum_j a_j^{\inf}}{M}; \frac{\sum_j a_j^{\sup}}{M} \right], \quad (20)$$

$a_j^{\inf/\sup}$ are the inferior/superior limits of the assessments of expert j, and M is the number of experts.

In order to determine the mathematical expectation of the couples of expertons we will be using fuzzy logic operators [11],[12]:

- $\wedge$ (and), in the case of conjunctive relations, meaning minimum;
- $\vee$ (or), in the case of disjunctive relations, meaning maximum. The relations between the entities, the sentences are expressed using logical symbols Δ (and) respectively ∇ (or).

Always, the elements from the left (the relative frequency f_a from the left-hand side of an experton is smaller or maximum equal to the value from the right-hand side). If these two frequencies are equal, in the square of the respective experton, the frequencies absolute/relative are written only once in the median side.

4. CASE STUDY

Let there be a technical system made from three equipments, identical from manufacturing and operational point of view which is described by „*k* out of *k+1*" redundant logic majority exploitation conditions. Because during an exploitation interval of 20 years there were noticed operational situations nonconforming to the technical rules and specifications, the management has asked an expertise to identify the equipment with a faulty time and operational behaviour.

The assessments of the experts are given in Table 3, according to the semantics from Table 1 and they describe three power transformers.

Table 3. The a assessments of the experts

E_i / e_j	E_1		E_2		E_3	
	A_{1j}	I_{1j}	A_{2j}	I_{2j}	A_{3j}	I_{3j}
e_1	B; AFB	0,861; 0,935	G	0,861	AVG	0,935
e_2	G	0,861	G	0,861	AVG	0,935
e_3	S;G	0,5; 0,861	G	0,861	S	0,5
e_4	G;VG	0,861; 1	G	0,861	AVG	0,935
e_5	AVG	0,935	G	0,861	AVG; VG	0,935; 1
$\sum_j I_{ij}$	*	4,018; 4,592	*	4,305	*	4,240; 4,305
$m(\sum_j I_{ij})$	*	4,305	*	4,305	*	4,2725
$m(\sum_j \frac{I_{ij}}{5})$	*	0,861	*	0,861	*	0,8545

Table 4. The expertons of the entities

k	α_k
1	0
2	0,055
3	0,169
4	0,5
5	0,861
6	0,935
7	1

E_l	f^a	f_c^a	$E_x(E_i)$
E_1	0	5	1
	0	5	1
	0	5	1
	1 0	5	1
	3 2	4 5	0,8 1
	1 0	1 3	0,2 0,6
	0 1	0 1	0 0,2
E_2	0	5	1
	0	5	1
	0	5	1
	0	5	1
	5	5	1
	0	0	0
	0	0	0
E_3	0	5	1
	0	5	1
	0	5	1
	1	5	1
	0	4	0,8
	4 3	4	0,8
	0 1	0 1	0 0,2

Table 5. The expertons of the couples $E_x(E_n \Delta E_m), n \neq m$

$E_x(E_n)$: $E_x(E_1)$ = 1, 1, 1, 1, 0,8 1, 0,2 0,6, 0 0,2

$\wedge$ $E_x(E_m)$: $E_x(E_2)$ = 1, 1, 1, 1, 1, 0, 0

$\Rightarrow$ $E_x(E_n \Delta E_m)$: $E_x(E_1 \Delta E_2)$ = 1, 1, 1, 1, 0,8 1, 0, 0

$\Delta\alpha$	$E_x(E_2)$	$E_x(E_3)$	$E_x(E_2 \Delta E_3)$
0	1	1	1
0,055	1	1	1
0,114	1	1	1
0,331	1	1	1
0,361	1	0,8	0,8
0,074	0	0,8	0
0,065	0	0 0,2	0

$\wedge$ $\Rightarrow$

$E_x(E_3)$: 1, 1, 1, 1, 0,8, 0,8, 0 0,2

$\wedge$ $E_x(E_1)$: 1, 1, 1, 1, 0,8 1, 0,2 0,6, 0 0,2

$\Rightarrow$ $E_x(E_3 \Delta E_1)$: 1, 1, 1, 1, 0,8, 0,2 0,6, 0 0,2

Table 6 gives the mathematical expectations of the couples of expertons $E(E_x(E_n \Delta E_m)), n \neq m$ according to relation (18), to the fuzzy operators and table 5. This table presents the average values of the mathematical expectations $m(E(E_x(E_n \Delta E_m))) = m_{m,n}$ and their ranking place corresponding to each equipment.

Table 6. The mathematical expectations of the couples of expertons

i	$E_m \Delta E_n$	$E(E_x(E_m \Delta E_n))$	$m_{m,n}$	The hierarhic place
1	$E_1 \Delta E_2$	0,7888;0,8610	0,8249	HP_2
2	$E_2 \Delta E_3$	0,8610;0,8610	0,8610	HP_1
3	$E_3 \Delta E_1$	0,8036;0,8462	0,8249	HP_2

So,

-equipment E_1 takes second place, associated to E_2 or E_3;

-equipment E_2 takes first place associated with E_3, and second place associated with E_1;

-equipment E_3 takes first place with E_2 and second place with E_1.

The following operational sequence is obtained: $E_2 - E_1, E_3$. So, $E_2(P)(E_1(I)E_3)$ where (I) and (P) are the symbols:

- (I) indiferency (de indiferenta indiferenta);
- (P) preferably.

5. THE PERFORMANCE FUNCTION

By referring to the three equipments as an aggregate, the concept of performance function [14], offers a correct image regarding the notion of average, in the case of fuzzy structures. For example, let there be the mathematical expectation of each entity. The value of the structure function is obtained using the relation:

$$\Psi = \max[\min(a;b);\min(c;d);...\min(k;l)]. \quad (21)$$

So,

$$\psi = \max\{\min[E_x(E_1 \Delta E_2)];\min[E_x(E_2 \Delta E_3)];$$
$$\min[E_x(E_3 \Delta E_1)]\} = 0,861.$$

We notice that the mathematical expectation of a couple of expertons is equal to the performance function: $E(E_x(E_2 \Delta E_3)) = \psi$.

Therefore, the same operational sequence is achieved:

$$E_2(P)(E_1(I)E_3).$$

The uncertainty persists even when we take in consideration the criterion minimum absolute hamming distance [13], dH_i [10], according to relations:

$$d_{H_1} = \left|E(E_x(E_2 \Delta E_3))) - E(E_x(E_1 \Delta E_2)))\right|;$$

$$d_{H_2} = \left|E(E_x(E_{23} \Delta E_3))) - E(E_x(E_3 \Delta E_1)))\right|,$$

Indeed $d_{H_1} = |0,0722|$ and $d_{H_2} = |0,0722|$.

We obtain the same operational sequence for the three equipments, without achieving a total differentiation based on the techniques used: $E_2(\mathrm{P})(\mathrm{E}_1(\mathrm{I})\mathrm{E}_3)$.

6. INFORMATION ENTROPY

We notice that the management does not have its question yet answered: which equipment should suffer preventive maintenance.
This paradox of rankings is eliminated when using the information entropy [15] concept.

Based on the information given in table 3, we can obtain, for each equipment, the frequency of each type of assessment, hence, we can establish the probability to obtain a certain assessment from a group of experts.
It is fair to notice that equipment E_1 has received from all experts five differentiated marks, with every mark having the same probability:

$$p_{1j} = \frac{f_{1j}}{\sum_j f_{1j}}, \quad j = \overline{1;5}, \tag{22.a}$$

$$p_{1j} = \frac{1}{5} \Rightarrow p(\mathrm{E}_1) = 0,2 . \tag{22.b}$$

The quantity that defines the level of certainty/chaos, regarding the phenomenological evolution of a certain entity is the entropy.

In the case we analyze, we will refer to the entropy in a Claude Shannon meaning. [16].

An image of the operational rankings, given in a R_i rank manner and achieved from the previous analyzing techniques is given in table 7.

Table 7. The operational ranks

E_i	Assesments	Expertons	Performance function	Hamming distance
E_1	R_1	R_2	R_2	R_2
E_2	R_1	R_1	R_1	R_1
E_3	R_2	R_2	R_2	R_2

The entropy of the evolution of each entity is obtained from the relation [16]:

$$H(\mathrm{E}_i) = -\frac{1}{\ln \mathrm{m}} \sum_i p_{ij} \ln p_{ij} , \tag{23}$$

where
$H(\mathrm{E}_i)$ is the entropy of E_i entity;
p_{ij} is the probability of A_{ij} assessment of an e_j expert on the E_i entity;
m is the number of experts.

In table 8 we find the values of p_{ij} probabilities, associated to A_{ij} assessments, according to the case study – table 3.

Table 8. The probability values

A_{ij} / E_i	S	S;G	G	G;AVG	G;VG	AVG	AVG;VG	$\sum_l f_l$ / $\sum_l p_{l_i}$
	$\frac{f_{l_i}}{p_{l_i}}$							
E_1	0	$\frac{1}{0,2}$	$\frac{1}{0,2}$	$\frac{1}{0,2}$	$\frac{1}{0,2}$	$\frac{1}{0,2}$	0	$\frac{5}{p_1}$
E_2	0	0	$\frac{5}{1}$	0	0	0	0	$\frac{5}{p_2}$
E_3	$\frac{1}{0,2}$	0	0	0	0	$\frac{3}{0,6}$	$\frac{1}{0,2}$	$\frac{5}{p_3}$

In this table, A_l represents the symbols of the l assessments used in this case study where l=7; f_{l_i} is the frequency of A_l assessment, for entity E_i and p_{l_i} is the probability of A_l assessment for E_i entity;
Table 9 highlights the levels of $H(\mathrm{E}_i)$ entropy, according to E_i entities optained using relation (23).

Table 9. The level of entropy

E_i	$H(\mathrm{E}_i)$ -bit	Observations
E_1	1	Chaos; absolute uncertainty
E_2	0	Maximum certainty
E_3	0,6	60% uncertainty

Hence, the assessment of the entropy associated to the operational status, achievede the differentiation of

the three equipments from a functional point of view. They are sequenced as follows: $E_2(\mathrm{P})\,\mathrm{E}_3(\mathrm{P})\,\mathrm{E}_1$.

The E_2 equipment shows a clear image regarding its operational status. It is described by the unanimous assessment of the experts – the mark good, at a maximum probability level, p(E_3), so a null entropy; maximum certainty.

The E_2 equipment has an acceptable entropic state, $H(\mathrm{E}_3) = 0,6$ bit and an operational potential diminished with less than 1%, but with lower entropic value.

The optimum solution to be presented to the management is to maintain as operational the transformers T_2 and T_3 and T_1 to be the subject of preventive maintenance.

Figure 3 shows the graph of the entropy depending on the probability associated to the respective technical entity.

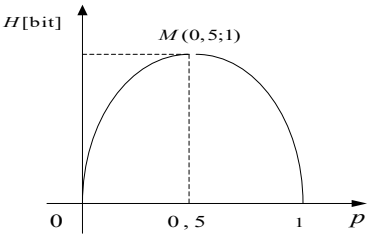

Figure 3 The graph of the function $H = f(\mathrm{p})$

We can notice that for p=0.5 probabilities the entropy is maximum; $H_{\max} = 1$ bit.

7. THE OPERATIONAL POTENTIAL

This concept refers only to the T_2 and T_3 aggregate, because the T_1 transformer is subject to preventive maintenance:

$$OP = \Psi p(\mathrm{E}_2 \Delta \mathrm{E}_3); \tag{24}$$

where,

- OP is the operational potential;
- Ψ is the performance function of the T_1 and T_3 aggregate;
- $p(\mathrm{E}_2 \Delta \mathrm{E}_3)$ is the probability of T_2 and T_3:

$$p_{23} = p_2 \square p_3. \tag{25}$$

In relation (25) we have:

$$\begin{cases} p_2 = p(\mathrm{E}_2) = 1 \\ p_3 = p_{31} \oplus p_{32} \oplus p_{33} \end{cases} \tag{26}$$

where ($\oplus$) is the logical sum, and the probabilities p_{31}, p_{32}, p_{33} match to the three marks proposed by the experts for the entity E_3: $p_{31} = p = 0,2$ – value matching to the (S) mark; $p_{32} = 0,6$ – value matching to the (AVG) mark, $p_{32} = 0,2$ – value associated to (AVG-VG) mark.

Transforming logical sum into algebraic sum we obtain:

$$p_3 = p_{31} + p_{32} + p_{33} - (\mathrm{p}_{31}\times\mathrm{p}_{32} + \mathrm{p}_{32}\times\mathrm{p}_{33} + \mathrm{p}_{33}\times\mathrm{p}_{31}) + \\ + \mathrm{p}_{31}\times p_{32}\times p_{33} = 0,744.$$

Consequently, $p_{23} = 1\times 0,744 = 0,744$.

We obtain the operational potential: $OP = 0,6406$. So, the E_2 and E_3 equipments are assessed on a seven-level, non-linear scale at a operational potential $OP = 0,861$ (which matches the assessment good) ,but with a probability of the technical system – the aggregate of the two transformers T_2 and T_3 we have $p(\mathrm{S}) = 0,744$.

8. CONCLUSIONS

The contribution of the experts in the process of assessment of the functionality of the technical equipments, facilitates the attainement of information, useful for the researcher in finding solutions in tasks related to the safety of various technical aggregates.

The assessment, however, cannot substitue probability, states a great specialist in this field, the french researcher Arnold Kaufmann. Hence, this type of expertise will have to match a thorough evaluation of the operational state of an equipment, during conclusive enough time intervals.

The evaluation of the operational probability based on a reliable exploitation documents always provides a strong information when fundamenting an optimum decision. The deep knowledge, the monitoring of the operational status at smartly chosen time intervals and also maintaining a constant severity during the research represents the optimum way to achieve the proposed goal.

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USING CURRENT-CONVEYORS FOR THE CONSTRUCTION OF RECTIFIERS

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ABSTRACT

The paper proposes two recovery circuits, a half-wave precision rectifier and a full-wave precision rectifier one. For these circuits use was made of the first commercially available current - conveyor based on the current-feedback op-amp., the CCII01, from LTP Electronics. For half-wave rectifier circuit, it is shown that, although non linearity of the diode is due to the diode voltage being non sinusoidal, the current across D_1 and R_S, like voltage across R_S, are accurate replicas of a recovered half-wave sinusoidal voltage.

Keywords: *current conveyors, half-wave precision rectifier, full-wave precision rectifier.*

1. INTRODUCTION

Current-mode circuits have as basic operational block, current-conveyors of the 2nd generation, denoted CCII. This current processor has the circuit symbol shown in Figure 1. The ideal current-conveyor of the 2nd generation provides the following functional relationships among the parameters in the circuit:

Voltage applied to Y input is repeated at terminal X:

$$v_x = v_y . \quad (1)$$

Current injected at terminal X is transported to Z output,

$$i_z = \pm i_x . \quad (2)$$

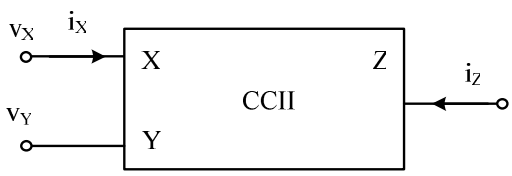

Figure 1 CCII symbol

In relation 2 if the sign is (+), the conveyor is not reversing and is denoted by CCII +. If the sign is (-) it is called reversing conveyor and symbolized CCII-.

The above accouts for the name of input / output terminal for terminal X that in terms of current is input and in terms of voltage , X is output.

It should also be known that an ideal current conveyor has infinite bandwidth and null equivalent input noise.

The first commercially available CCII was PA 630 by company Phototronix followed by CCII01 manufactured by LTP Electronics. From a simple analysis of these circuits it is observed that criteria specific for functional relationships 1 and 2 of CCII are met.

2. CCII PRECISION RECTIFIERS

Another equally elegant use of the current-conveyor is for high speed precision rectification. The classical problem with conventional precision rectifiers based on diodes and op-amps is that during the non-conduction/ conduction transition of the diodes the op-amps have to recover with a finite small-signal dV/dt resulting in significant distortion during the zero-crossing of the input signal.

Using high slew-rate op-amps does not solve this fundamental drawback since it is a small-signal transient problem. Conventional rectifiers are thus limited to a frequency performance well below the gain-bandwidth product of the amplifier. Improvements have been made to rectifier high frequency performance by the use of current-mode techniques primarily based upon employing the power supply rails of the op-amp as a current rectification path. However, a problem encountered with such schemes is that signal levels need to be significantly higher than the supply bias to guarantee precision rectification at high frequency and so again loss of precision occurs at signal zero-crossings.

Even using high speed current-feedback amplifiers the performance is still limited to some tens of kiloHertz, whitch is significantly below the fT of the current - feedback amplifiers used.

One of the applications where the current mode advantage, in terms of high speed, is highlighted directly is represented by power rectifiers.

They use the CCII01 which is built on a high speed dielectric isolation fully complementary bipolar process and supplied as dual device in an 8 -pin DIL package. The device features an equivalent slew-rate of 2000 V/µs and 100 MHz bandwidth. The equivalent open -loop gain is 80dB and the CMRR performance is better than 53 dB at 1 MHz. The maximum output current from the device is ±10mA and it operates from ±5V to ±15V supplies.

A. Half-Wave Precision Rectifier

The simplest circuit of half-wave rectifier with CCII is prezented in Figure 2. As shown in the circuit, the

conveyor is fitted on a connection of voltage-current converter. The positive half-wave of current i_z, proportional to the input voltage, will circulate through the diode D_1 and R_S load. In the negative half-wave of current i_z, current is closed through diode D_2 because the current across D_1 and R_S is zero. Thus voltage v_0 appearing across R_S is half-wave rectified. We can say that recovery thus achieved is a precision recovery because there is no threshold current over which the diode D_1 enters conduction. The diode nonlinearity is manifested by the fact that voltage across diode is not sinusoidal , even if current across D_1 and R_S like voltage across R_S are exact replicas of a recovered half-wave sinusoidal voltage.

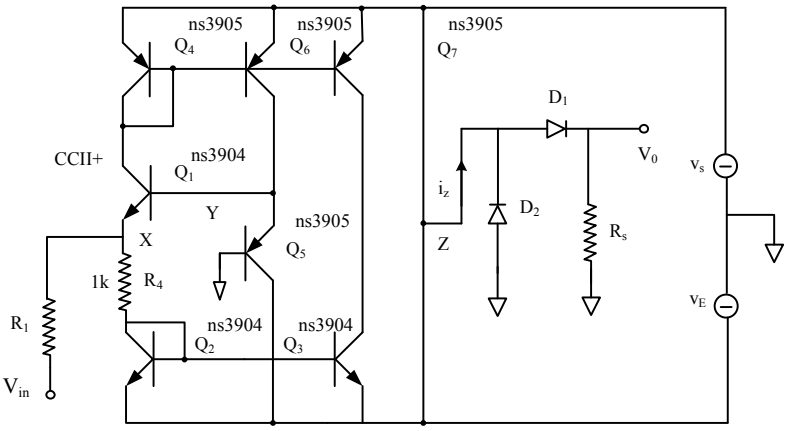

Figure 2 Half-wave precision rectifier

The circuit was built with 100Ω resistors and Schottky diodes and Figure 3 shows typical performance for the half-wave precision rectifier shown in Figure 2 at two operating frequencies, 100 KHz and 1 MHz. The performance is good but with CCII01 exhibiting an f_T of approximately 100MHz, one would naturally expect the circuit to work close to the f_T of the device. However, this is not the case since at very low signal levels all the diodes are off, and as a result the differential voltage to current converter is transformed into a high gain differential voltage amplifier.

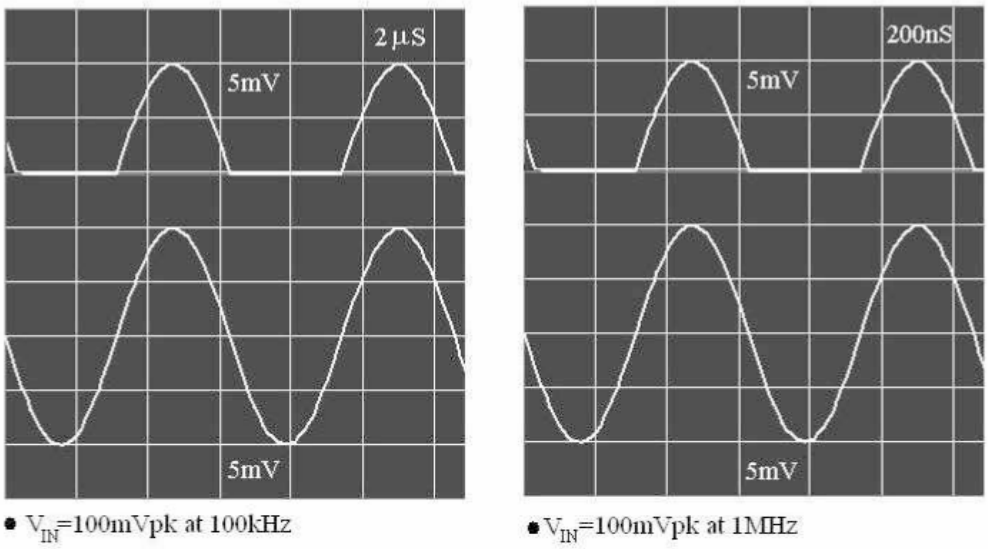

Figure 3 Half-wave precision rectifier- wave forms

B. Full-wave precision rectifier

To get a full-wave rectifier in the previous circuit, resistance $R_S = R_2$, instead of being grounded, will be connected to the input as in Figure 4. Across the positive half-wave of the input voltage, current i_x enter the terminal X and current i_z enters the Z output, circulating through D_2 (continuous line route). Current through D_1 and D_2 is zero because diode D_2 is reverse polarized and D_1 is polarized with $+V_{in}$ on both electrodes, both through Z output and R_2.

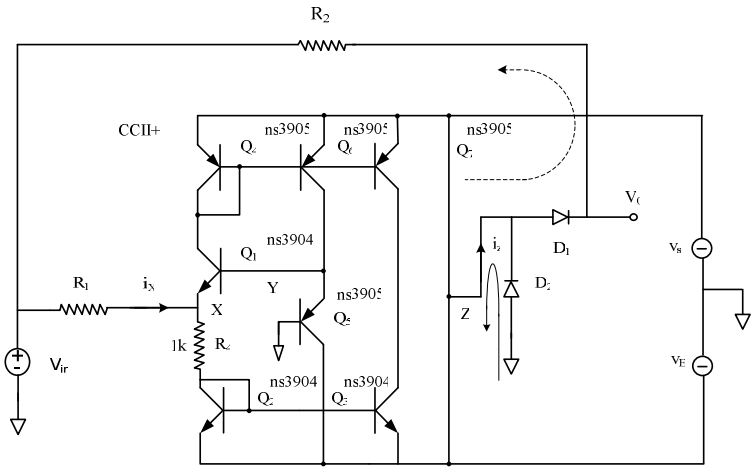

Figure 4 Full-wave precision rectifier

Therefore there is no potential difference across it and it does not open. As a result;

$$v_0 = v_{in} . \quad (3)$$

On the negative half-wave of the input voltage , current i_x, equal as absolute value with v_{in}/R_1, gets out of terminal X and therefore current i_z will exit the terminal Z and will circulate through D_1 and R_2 (dotted path).

Because $v_{in} < 0$ the output tension becomes,

$$v_0 = i_2 \times R_2 - (-v_{in}) = i_2 \times R_2 + v_{in} . \quad (4)$$

But $i_x = \frac{-v_{in}}{R_1}$ and if ;

$$R_2 = R_1 , \quad (5)$$

$$v_0 = 2 \times R_1 \times i_x + v_{in} = -2 \times v_{in} + v_{in} = -v_{in} . \quad (6)$$

Relations (3) and (6) can be written compactly,

$$v_0 = |v_{in}| . \quad (7)$$

i.e. the circuit provides a rectified full-wave output voltage. Rectifying is a precision rectifying one.

The main drawback of the rectifier in Figure 4 is that the precision of recovery is conditioned by how equality is fulfilled (5).

Using the present day current-conveyors, which have the pass-band of the order of 100MHz, the max. frequencies up to which rectifiers work are limited by the type of diode used. By using Schottky diodes good behavior is obtained up to frequencies of (4-5) MHz.

3. CONCLUSIONS

The performances of the CCII 01 circuit are high, providing a f_T frequency of about 100 MHz, so, as it was expected, the rectifier circuit works at low frequencies comparable with those offered by device. However, this is not the case since at very low signal levels all the diodes are off, and as a result the differential voltage to current converter is transformed into a high gain differential voltage amplifier. Although the CCII01 exhibits a very high slew-rate, in the region of 2000V/µs, it is the small signal dV/dt that limits performance at zero-crossings. However the measured results are encouraging and represent a significant improvement.

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HYDROSTATIC AND STABILITY CHARACTERISTICS FAST DETERMINATION

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ABSTRACT

The article presents a fast determination for a hydrostatics and stability based on Autoship software for a 55.000 t.d.w. ship. Available software in Ship Construction Laboratory is presented in the method of fast determination ship stability.
ModelMaker component is used for drawing geometric shapes and Autohydro software is used to generate a fast report for any load case and a stability book for onboard use. Generated report contains righting arm information and diagram.

Keywords: *ModelMaker, hydrostatic, stability, 55.000 t.d.w. ship.*

1. INTRODUCTION

All modern stability laboratories are fitted with equipment for fast understanding of the stability concept using models. In Ship Construction Laboratory we use Autoship software for a state of art fast analysis for hydrostatics and stability.

The Auto*ship* hull design/surface modelling program combines the graphical user interface of Windows with the dexterity of NURBS (Non-Uniform Rational B-Spline) mathematics, the high-end CAD standard for surface modelling, to give you the tools to quickly and efficiently create any hull shape from a racing yacht to a super tanker, including the superstructure and appendages.[4,5]

The work is based on dimensions of a 55.000 t.d.w. ship presented in section 2 and Figure 1 and 2.

2. 55.000 t.d.w. ROMANIAN SHIP DATA

L.O.A.…….…….L_{max} = 220 *m*
L_{WL}……..…..L_{cwl} = 216,38 *m*
Breadth…… *B* = 32 *m*
Draught…… *d* = 12,4 *m*
Deadweight…….…… D_W = 55.000 *t.d.w.*
Speed……...v_N = 16 *Nd*

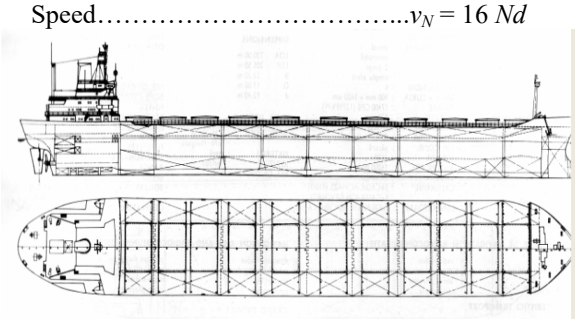


Figure 1 55000tdw bulk carrier

3. DRAWING GEOMETRIC SHAPES IN MODELMAKER

Autoship software allows building ship geometrical shapes with the component ModelMaker. Fast calculation for hydrostatics can be done in any loading state using Autohydro. ModelMaker is used to produce vessel models, which are saved as Geometry Files (GFs). Autohydro is then used to analyze those models under different load conditions to get hydrostatics and stability [1].

CLASSIFICATION SYMBOL: RNR CM M 0 G20

TONNAGES

GT : 32100
NT : 23034
DWT : 54158

DIMENSIONS

LOA : 220.00 m
LBP : 205.50 m
B : 32.20 m
D : 17.00 m
d : 12.40 m

HULL DETAILS

SHIPBUILDER : S.N. Galaţi, S.N. Mangalia
MATERIAL : steel
JOINT : welded
NO. OF DECKS : 1

MACHINERY DETAILS

ENGINEBUILDER : I.C.M. Reşiţa, Kawasaki Heavy Industries
MAKE : MAN
TYPE : K6SZ90/160
OPER. PRINCIP. : diesel, reversible, two strokes, single acting
NO. OF CYLIN. : 6
BORE * STROKE : 900 mm * 1600 mm
POWER : 17400 bhp (12799 kW)
REVOL. SPEED : 122 rpm
TRANSMISSION : direct
PROPELLERS : FBP
FUEL TYPE : heavy fuel oil
FUEL BUNKERS : 3629 t
RANGE : 16000 nM
SPEED : 16 knots
BOILERS : 1*AuxB-WT-OF(110/7), 1*Aux-FT-ExG(368/7)
GENERATORS : 2*630 800kVV 380V 50Hz

NAVIGATION AIDS AND RADIOCOMMUNICATION EQUIPMENT:

direction finder, echo sounding device, electric log, gyro-compass, position fixing device, radar, radio-station, radio-telephone

CARGO DETAILS

GRAIN CAPACITY : 75516 m³
NO. OF HOLDS : 7
NO. OF HATCHES : 10
HOLD LENGTHS : 16.83 28.80 17.10 27.00 17.10 29.70 15.30
HATCH DIMEN. : 10*(11.70*15.60)

SISTER SHIPS:

Balota, Balş, Băileşti, Blaj, Borşa, Brăuleşti, Buhuşi

Figure 2 55000tdw bulk carrier data

A Geometry object is a collection of groups of 2D cross sections that together define the ship shape. Each group of cross sections, or "part", describes a particular piece of the vessel model such as a hull or a compartment.

Parts are assigned attributes, such as name, side factor, class, contents, and specific gravity. Any number of parts can be made, but one of them must be named "Hull" - if no part is named Hull, Autohydro cannot process the GF file. All parts are made up of components.

Components also take on attributes, such as side designation and permeability. Components may be joined together to produce a single, complex volume. You can fit or trim components with each other inside ModelMaker menu.

The model of ship, and the coordinates of the vertices that define it, are shown in Model Maker's main screen. Also included in the main screen are the tools

required to create, edit, or delete the components and parts. You control Model Maker by using the menus, tools, and the extensive list of commands available (commands are input using the CMD (or "Command") [6,7] Menu, which calls the Command File Editor.

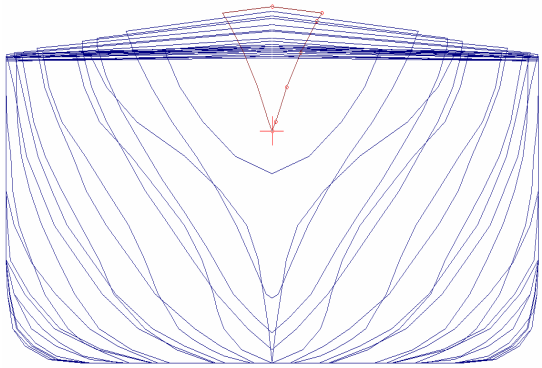


Figure 3 Ship in Modelmaker

Figure 4 Ship in Modelmaker

Figure 5 Ship in Modelmaker

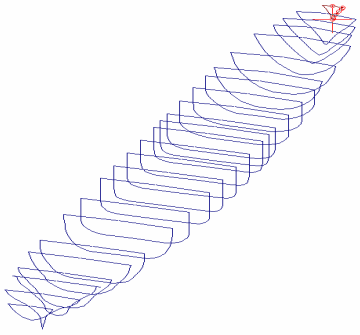


Figura 6 Nava în Modelmaker în vedere isometrică

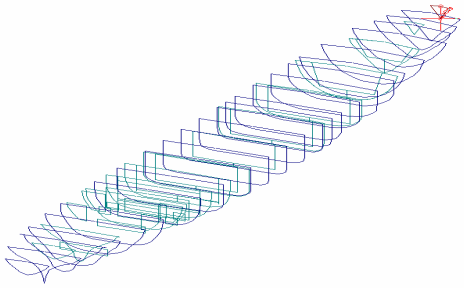


Figure 7 Nava în Modelmaker în vedere completă isometrică

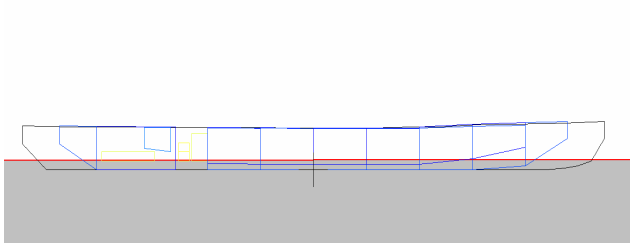


Figure 8 Nava 3D în Autohydro plutire pescajul corespunzător navei goale, vedere pe planul diametral

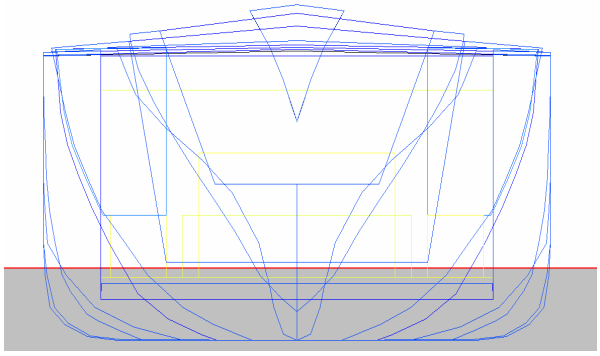


Figure 9 Nava 3D în Autohydro vedere pe planul transversal

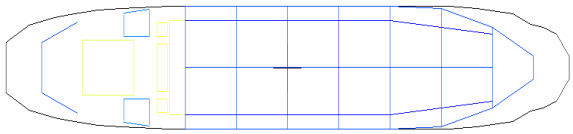


Figure 10 Nava 3D în Autohydro plutire pescajul corespunzător navei încărcate la maxim, vedere pe planul diametral

Autohydro is a complete hydrostatics and stability calculations program for naval architects, ship designers and marine engineers:

- Autohydro is a true "floating simulator" - it calculates the reaction of a vessel model to specified conditions, which can include loading configuration, damage, wind, and high speed turning momentum.
- Vessel attitude is displayed both graphically and in text on the screen.
- Graphical and printed reports can be displayed, edited, printed, saved, or exported to other Windows applications.
- Autohydro can also be used to obtain hull form characteristics and capacities.[6]

Autohydro reads the geometry file describing a vessel, and uses it to calculate hydrostatic characteristics. Modelmaker creates and edits the data files at the root of vessel models; and these data files are referred to as Geometry Files (GFs).[7]

Both of these program modules, Autohydro and Modelmaker, have their own screens, sets of functions, menus, and commands and it is a huge mistake that are designed as separate software tools.

When a GF is completed in Modelmaker, it is loaded into the Autohydro module. The model appears in the Autohydro screen according to the conditions you set. Within Autohydro you can analyze the model in three distinct ways:

1. Given draft, trim, and heel weight you can solve for center of gravity;
2. Given weight(s) draft, and trim, you can solve for heel; and
3. Given waterlines, you can solve for vessel characteristics.

To perform these above three tasks, use these three methods:

1. Type a command (e.g., DRAFT) and values (e.g., 1.25 @ 20a 1.20 @ 20f) on the command line for the task you want Autohydro to perform;
2. Choose a command from one of the menus; or
3. Edit and process commands in a RUN file.

Putting together the appropriate sets of instructions allows you to analyze the model in different conditions. Autohydro shows the vessel's current situation graphically in the three different views on the screen, and also as text and values in the Hydrostatics window.

Various reports describing the characteristics or stability of the vessel are available by using the appropriate menu command. By assembling the reports in the right order, you can produce a stability book for onboard use.

4. INTEGRAL REPORT OF AUTOHYDRO SOFTWARE

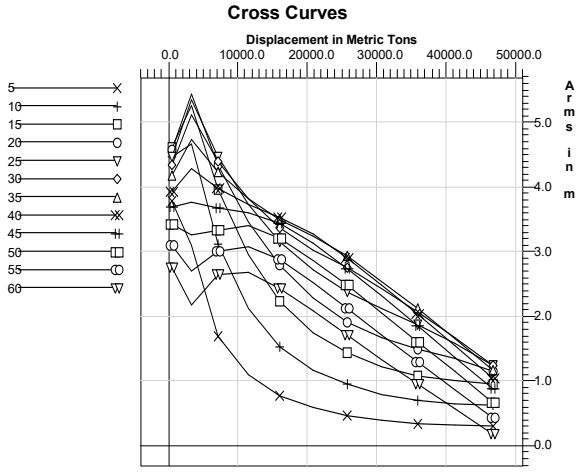
Cross Curves of Stability

Righting Arms(heel) for VCG = 8.97

Trim fwd 0.51 deg. at heel = 0 (RA Trim = 0)

Displ (MT)	10.000s	15.000s	20.000s	25.000s	30.000s
402.54	4.468s	4.624s	4.581s	4.479s	4.348s
3187.9	4.673s	5.276s	5.445s	5.354s	5.115s
7082.6	3.128s	3.969s	4.352s	4.466s	4.405s
11386.	2.129s	2.956s	3.469s	3.731s	3.829s
15955.	1.543s	2.239s	2.798s	3.167s	3.384s
20720	1.184s	1.758s	2.290s	2.725s	3.039s
25643	0.953s	1.440s	1.925s	2.382s	2.760s
30710	0.804s	1.230s	1.673s	2.124s	2.446s
35916	0.711s	1.096s	1.509s	1.875s	2.078s
41262	0.658s	1.016s	1.366s	1.586s	1.677s
46733	0.636s	0.960s	1.164s	1.247s	1.243s
Displ (MT)	**40.000s**	**45.000s**	**50.000s**	**55.000s**	**60.000s**
402	3.942s	3.702s	3.430s	3.114s	2.763s
3187.	4.298s	3.778s	3.262s	2.713s	2.179s
7082	3.980s	3.676s	3.347s	3.009s	2.657s
11386	3.732s	3.604s	3.409s	3.079s	2.684s
15955	3.541s	3.453s	3.217s	2.886s	2.437s
20720	3.277s	3.134s	2.868s	2.523s	2.101s
25643	2.914s	2.739s	2.486s	2.137s	1.721s
30710	2.499s	2.330s	2.061s	1.723s	1.338s
35916	2.050s	1.869s	1.612s	1.303s	0.953s
41262	1.560s	1.384s	1.153s	0.879s	0.574s
46733	1.051s	0.885s	0.679s	0.444s	0.186s

Water Specific Gravity = 1.025.



Hull Data (with appendages)

Baseline Draft: 3.093 at Origin
Trim: fwd 0.51 deg.
Heel: zero
DIMENSIONS
Length Overall: 220.000 m LWL: 220.147 m
COEFFICIENTS
Prismatic: 0.624 Midship: 0.794 Waterplane: 0.728
RATIOS
Length/Beam: 7.639 Displacement/length: 35.954
Beam/Depth: 7.420
MT/ cm Immersion: 44.723
AREAS
Waterplane: 4363.168 m^2 Wetted Surface: 4869.041 m^2
Under Water Lateral Plane: 636.370 m^2 Above Water Lateral Plane: 2368.139 m^2
CENTROIDS (Meters)
Buoyancy: LCB = 7.130 fwd TCB =0.000 port VCB = 1.713
Flotation: LCF = 3.147 fwd
Under Water LP: 8.438 fwd of Origin, 1.545 below waterline.
Above Water LP: 0.597 fwd of Origin, 5.563 above waterline.

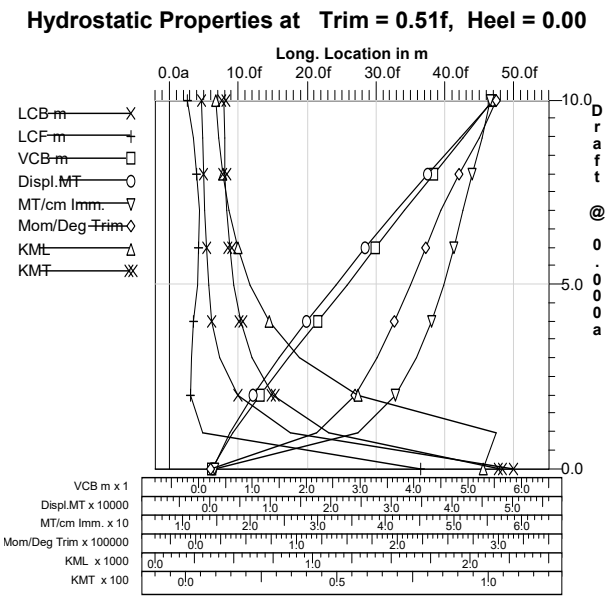
Hydrostatic Properties

Draft is from Baseline.
Trim: fwd 0.51 deg., No heel, VCG = 12.000

Draft at Origin (m)	Displ (MT)	TPcm (MT/cm)	MTcm (MT-m/deg)	KML (m)	KMT (m)
0.000	402	14.645	14555	2,083.516	103.961
1.000	3187	35.904	119891	2,166.430	47.204
2.000	7082	41.311	157548	1,286.325	28.685
3.000	11386	44.480	179605	915.605	21.706
4.000	15955	46.758	197033	719.443	18.060
5.000	20720	48.456	212241	598.799	15.782
6.000	2564	49.933	227564	520.383	14.358

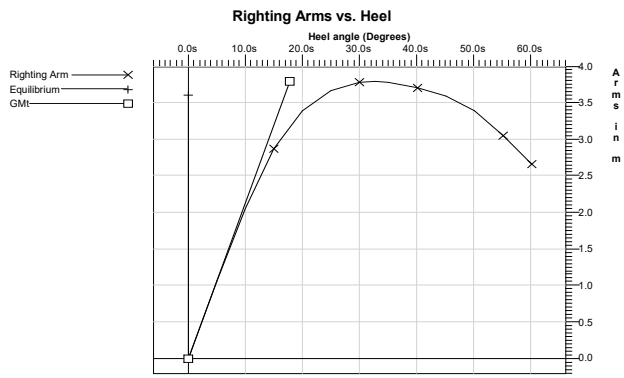
7.000	30710	51.316	243071	465.432	13.490
8.000	35916	52.710	260714	427.848	12.953
9.000	41262	54.124	280407	401.313	12.649
10.000	46733	55.386	297993	377.291	12.525

Water Specific Gravity = 1.025.



Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)
0.00	0.51f	3.093	0.000
5.00s	0.51f	3.057	1.064
10.00s	0.50f	2.948	2.061
15.00s	0.49f	2.744	2.877
20.00s	0.49f	2.416	3.400
25.00s	0.49f	1.964	3.672
30.00s	0.50f	1.402	3.781
32.66s	0.50f	1.065	3.792
35.00s	0.51f	0.748	3.783
40.00s	0.52f	0.005	3.709
45.00s	0.53f	-0.817	3.592
55.00s	0.56f	-2.564	3.057
60.00s	0.58f	-3.442	2.664



5. CONCLUSIONS

The naval software products are used to increase productivity and work speed of the naval engineer while maintaining high 3D model quality. Autoship ASC is used in building ship models and the Autohydro report presents all hydrostatic and stability properties.

The article presented a fast determination for a hydrostatics and stability based on Autoship software for a 55.000 t.d.w. bulk carrier ship and all data can be used onboard as stability book. Available software in Ship Construction Laboratory: ASC Autoship is presented in the method of fast determination ship stability. ModelMaker component was used for drawing geometric shapes and Autohydro software was used to generate a fast report for any tested load case. Generated report contains righting arm information and diagram.

Autoship ASC product helps the engineers for analysis in order to obtain optimized different forms of ships. Autoship can be used to determine the lowest value in shear forces and bending moments and this is important in analyzing loading scenarios.

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ANSYS AND AUTOSHIP NUMERICAL SIMULATION FOR SHIP MODEL

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ABSTRACT

The article shows results for geometry and drag using techniques for a Computational Fluid Dynamics study based on SST model and Autoship software for the newest equipment available in Applied Stability Teaching Laboratory. Model is fixed and the fluid motion is generated from boundaries limit and initial values. Boundaries settings are presented for each type of selection and results for geometry in Modelmaker, Solidworks and Ansys drag based on SST model simulation analysis are presented.

Keywords: *Ansys, Autoship, properties, ship model.*

1. INTRODUCTION

All modern stability laboratories are fitted with equipment for fast understanding of the stability concept using models. The presented paper is describing the first stability model developed for practical understanding using geometry and software available like: Autoship, Solidworks and Ansys.

The model presented in fig. 1 and 2 is a way to investigate ship stability and to understand how to manage stability onboard merchant ships.

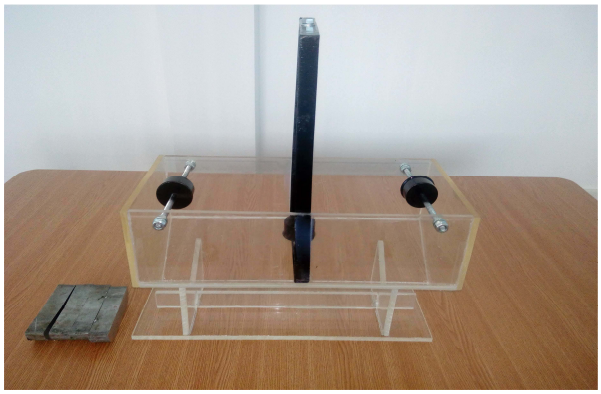


Figure 1 Ship model lateral view

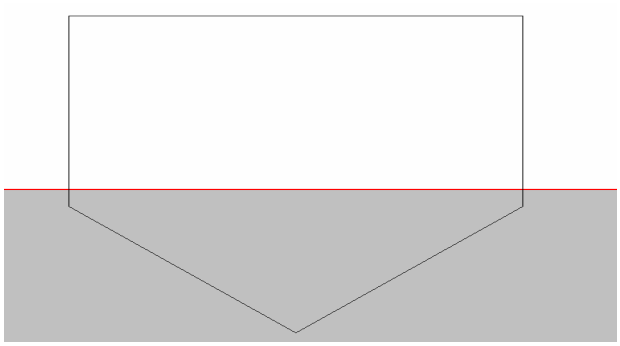


Figure 2 Ship model floating simulation in Autoship

2. GEOMETRY MODELLING USING SOFTWARE

2.1. Building model geometry in ModelMaker

ModelMaker is a component of ASC Autoship software and the software was proiected for ship design. Due to simple forms the model in ModelMaker is an easy task and the results generated are presented in Figures 3 and 4.

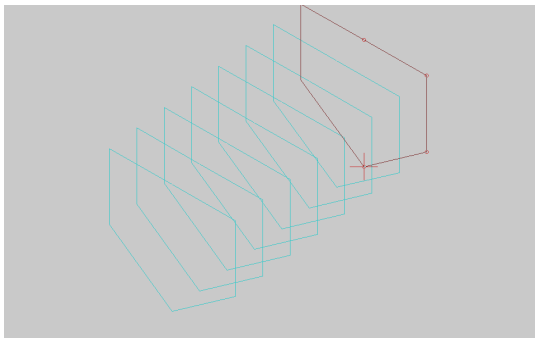


Figure 3 Modelmaker model- working in isometric view

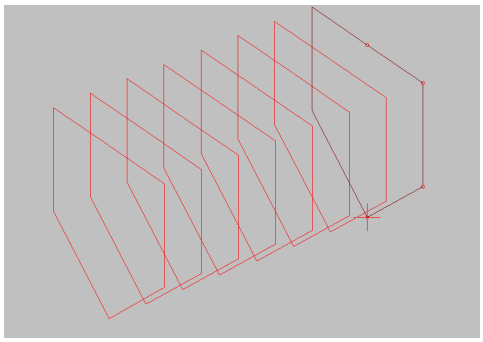


Figure 4 Modelmaker model-final project isometric view

2.2. Building model geometry in Solidworks

Solidworks software is used in 3D computer aided design developed by DAS using Microsoft Windows OS. The distinctive features of program design Solidworks are:

1. Surface parametric solid modelling.
2. Full associatively between parts, assemblies and drawings.
3. An interface import/export geometric files (compatible with several software).

4. Flexibility and scalability.
5. Special tools for working with large assemblies.
6. The high functionality.
7. Fast menu accessibility tools.
8. Compliance 100% of design drawings according to the common system for design documentation.
9. Menu interface and documentation in multiple languages.

To create the model geometry we used Solidworks program and the result is presented in Figure 5.

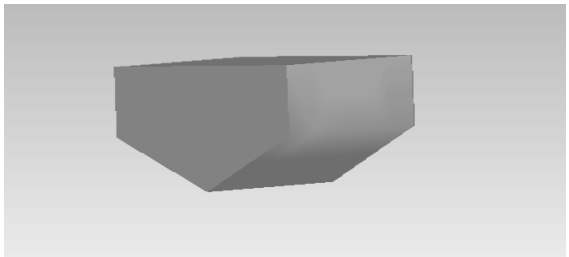


Figure 5 Lateral View for Solidworks geometry

2.3. Building model geometry in Ansys for CFD analysis

DesignModeler is used in solid modelling features and parameters used to create models like model presented in Figure 6.

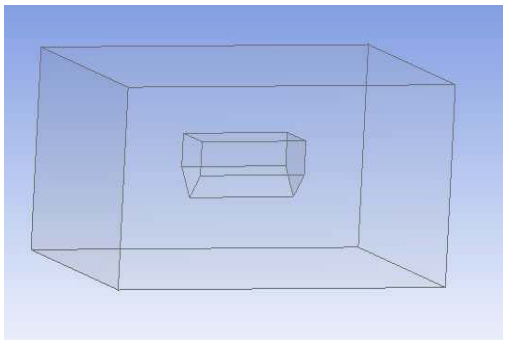


Figure 6 Boolean subtract for fluid flow analysis

Numerical parameters can be associated with relationships that allow an overview of design Parameters (Parameters) refers to limitations whose values determine the shape or geometry or assembly. Parameters can be numeric as well as a line length or diameter circle or geometric like tangent, parallel, concentric, horizontal or vertical..

The process of building 3D models is based on creating three-dimensional geometric elements and conducting various operations between these models. The model is made of standard elements (blocks), and can be edited by adding or removing these items, or by changing the parameters characteristic of these blocks. 3D model carries within itself a description more complete physical properties of the object (volume, mass, inertia) and provides designers the opportunity to work in a virtual 3D, which enables the highest level of a computer to form and you create the look of future product, except for the prototyping stage.

3. STUDY PARAMETERS USING SOFTWARE ANSYS CFD AND AUTOSHIP
4.

Software from Ansys (fig.7.) engineering simulation supports being used to see how the model or production processes that fit in a real environment.

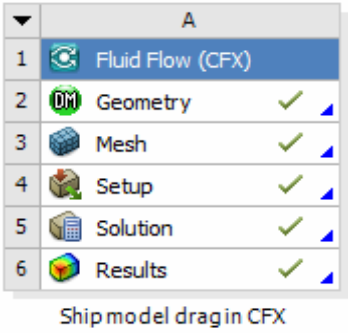


Figure 7 Ansys CFX solver

Simulation CFD helps Ansys to analyze the influence it has on fluid flow model. Fluid flow analysis capabilities uniform can be used to model and optimize equipment and to identify problems at the production facilities of whether the phenomenon of the fluid is monophasic or multiphase insulated or not, compressible or incompressible.

Ansys CFD solutions are integrated in the Ansys Workbench platform which can be solved using three steps: pre-processing and post-processing simulation. This platform enables optimization or model study.

In order to achieve the simulation to calculate the drag was considered the model boat made in DesignModeler and was imported in Ansys CFD.

In order to use Ansys Workbench software design suite 15.0, was resorted to represent the real scale 1:1 [4,5].

Lenght…….L_{max} = 42 *cm*
Beam…… B = 25 *cm*
Draft…… d=10 *cm*
Displacement …… D_W = 2,5 *kg*
Speed……...v_N = 12 *Nd*

The model thus obtained was placed in a field as you figure below.

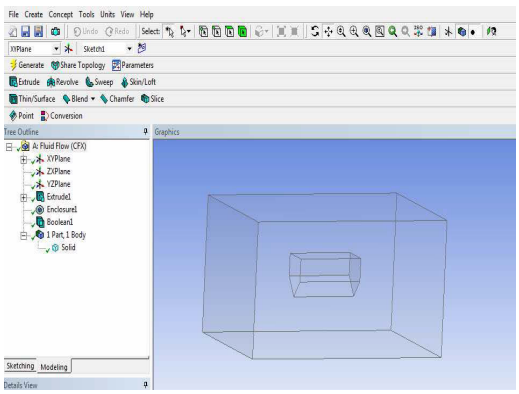


Figure 8 Domain used in the simulation field calculation

In the phases of simulation, it has developed a structured method discretized structure CutCell (Fig.9.)

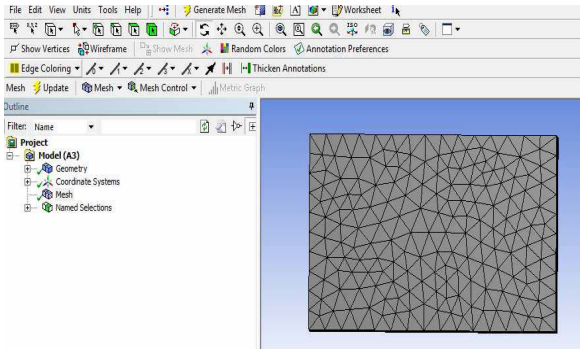


Fig. 9. Discretized domain

To obtain more accurate results but also to allow a swift convergence of computing iterations was preferred discretized refine the structure of the hull so that the maximum length of an item is 0.05 m.[2,3]

Next steps, passed during the simulations assumed the definition of boundary conditions, as the follows:

- Receiving fluid into the calculation at a speed from 3 m/s to 7 m/s ;
- Fluid out of the calculation, considering a static pressure of 1 bar;
- "Walls" side of the field, receiving impose a condition of "free slip wall", in which case consider the following:

1. All components at normal speeds wall surface are void;
2. The gradient of velocity components normal to the wall is void;
3. Tensions in the wall are void;

- Hull, which was imposed a condition such as "no slip wall", which are subject to the following statements: the conditionality applied viscous fluids, specifies that there is a solid obstacle against which the flow rate will be zero; a limit velocity of the fluid in the fluid - solid will be equal to that of the solid.

Swirl pattern used is "Shear - Stress Transport (SST)" model originally developed by Menter, combine the robustness of the model k – ω[1] in the boundary layer region free advantages in the current modelling removed model k - ε. To obtain the same development model k - ε is incorporated in the formulation k - ω. The vortex is similar to the standard model SST k - ω, but includes the following features:

- The standard k - ω model turned k - ε is multiplied by a function of combining and both models are combined. Merge function will have value 1 in the boundary layer at which time the active model is standard k - ω; in the far boundary layer function is zero, thus activating model k - ε transformed.
- SST model includes a term derived from the amortization period ω equation;
- Modelling constants have different values than the standard models k - ω and k - ε.

These features make the model SST k - ω to be more accurate and stable for a wider range of flow than the standard k - ω. The changes included in the term ω equation makes it possible to correct behaviour of the model, both in the boundary layer areas, and on the far there from.

The SST k - ω model has a shape similar to standard k - ω:

$$\frac{\partial(\rho k)}{\partial t}+\frac{\partial(\rho k u_i)}{\partial x_i}=\frac{\partial}{\partial x_j}\left(\Gamma_k\frac{\partial k}{\partial x_j}\right)+\tilde{G}_k-Y_k+S_k$$

and

$$\frac{\partial(\rho\omega)}{\partial t}+\frac{\partial(\rho\omega u_i)}{\partial x_i}=\frac{\partial}{\partial x_j}\left(\Gamma_\omega\frac{\partial\omega}{\partial x_j}\right)+G_\omega-Y_\omega+D_\omega+S_k$$

In these equations, Gk is generating momentum swirl determined gradients of the main gear. G_ω is generating ω term. Γ_kşi Γ_ω is effective diffusivity of the terms k and ω. Ykşi Yω terms k and ω is the dissipation due to turbulence. Dω, Sk and is Sw source terms, defined for this experimental model.

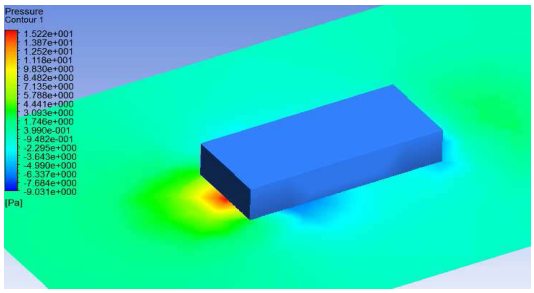


Figure 10 Variations in the pressure at speed of 5 m / s

Simulation has been defined for a duration of 1000 seconds, with an increment of 2 seconds. For each step of calculation is performed three iterations.

The Figures 10, 11 and 12 (below) present comparative distributions pressure, velocity profiles at speeds from 3m/s to 7 m/s.

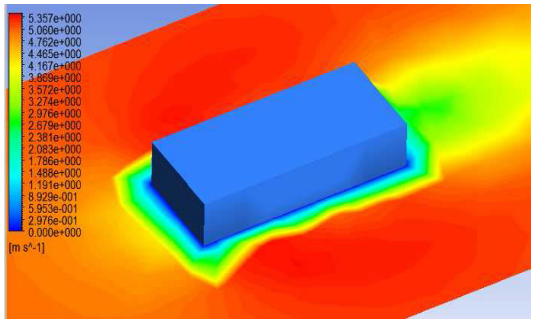


Fig. 11. Variations in the speed at speed of 5 m/s

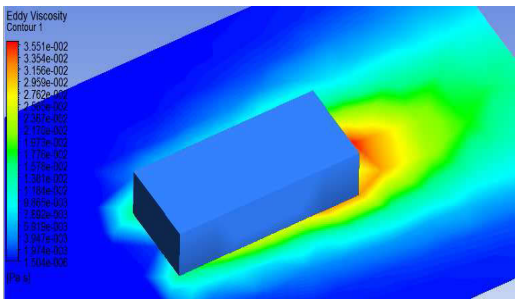


Figure 12 Variations in eddy viscosity at speed of 5 m/s

Table 1. Mesh Information for CFX

Domain	Nodes	Elements
Default Domain	11930	29027

Table 2. Domain Physics for CFX

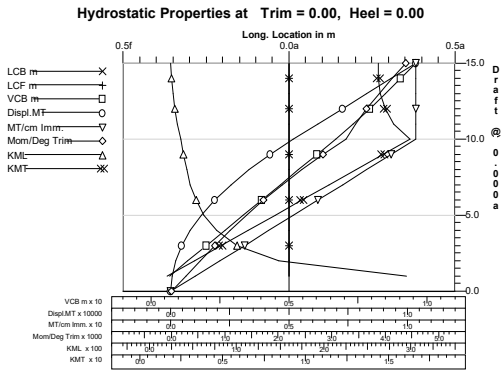
Domain - Default Domain	
Type	Fluid
Location	B31
Materials	
Air at 25 C	
Fluid Definition	Material Library
Morphology	Continuous Fluid
Settings	
Buoyancy Model	Non Buoyant
Domain Motion	Stationary
Reference Pressure	1 [atm]
Heat Transfer Model	Isothermal
Fluid Temperature	25 [C]
Turbulent Wall Functions	Scalable

5. HYDROSTATIC RESULTS

Draft is from Baseline.
No Trim, No heel

Draft (cm)	Displ (kg)	VCB (cm)	TPcm (kg/cm)	MTcm (kg-cm /deg)
0.000	0.000			
1.000	51.661	0.667	1.033	265.718
2.000	206.64	1.333	2.066	535.043
3.000	464.95	2.000	3.100	811.581
4.000	826.57	2.667	4.133	1098.94
5.000	1291.5	3.333	5.166	1400.72
6.000	1859.7	4.000	6.199	1720.55
7.000	2531.3	4.667	7.233	2062.01
8.000	3306.3	5.333	8.266	2428.72
9.000	4184.5	6.000	9.299	2824.29
10.00	5166.1	6.667	10.3	3252.29
11.00	6199.3	7.306	10.33	3441.66
12.000	7232.5	7.905	10.33	3649.06
13.000	8265.7	8.479	10.33	3874.49
14.000	9298.9	9.037	10.33	4117.96
15.000	10332	9.583	10.33	4379.46

Water Specific Gravity = 1.025.



6. CONCLUSIONS

This work has presented 3 different geometries for the same object in Autoship, Solidworks and Ansys. Also, based on geometry from DesignModeler and using SST equations the drag values and boundaries settings are presented as good practical example for ship model.

In this analysis we presented the water flow around the ship model available.

The results of this model study may help students from naval universities to understand the shipbuilding industry.

The software products are used to increase the productivity of the designer, quality improvement model. DesignModeler is used in solid modelling and parametric characteristics used to create models. Ansys CFD results on drag helps the engineers for analysis in order to obtain optimized ships shapes.

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RELIABILITY OF NUCLEAR SAFETY AND CONTROL SYSTEMS

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ABSTRACT

The main role of electronic systems for safety and control in nuclear installations is to detect hazards, to initiate emergency systems and auxiliary cooling circuits, and to start alarm systems for exposed areas evacuation. Most of these digital and analogic systems that provide the above mentioned functions have enough precision to allow a safe operation of nuclear installations. Modern safety and control systems used in nuclear installations works in complex situations, with a large number of inputs, in different operating scenarios and a large number of optimization criteria. Actual requirements concerning nuclear installations safety and control involve utilisation of complex structures with hundreds of measurement loops, data acquisition and processing systems, interlocks and tripping systems, Assuring reliability of physical systems and of automated operation can not be accomplished only by using redundant systems and voting systems.

Keywords: *Adaptive system, nuclear, safety, control systems.*

1. INTRODUCTION

The main role of electronic systems for safety and control in nuclear installations is to detect hazards, to initiate emergency systems and auxiliary cooling circuits, and to start alarm systems for exposed areas evacuation.

Most of these digital and analogic systems that provide the above mentioned functions have enough precision to allow a safe operation of nuclear installations.

However electronic systems may show up operational failures due to low reliability of equipments or false tripping signals, and require complex maintenance completing.

One of the weakness point of the safety and control systems for critical installation is the sensitivity to unjustified decisions for emergency trip.

A long operation with safety parameters close to trip level values result in temporary data misinterpretation (electric glitches, software errors) or hardware/software failures (problems with power supply or data transmission).

All statistics performed for nuclear installations showed a large amount of unplanned shutdown actions; the initiating event slightly varies due to installation type and to logical voting system complexity.

The above mentioned drawbacks were mostly removed by means of digital systems with distributed control and control systems fail-tolerant.

Also these type of systems allow digital filtering adapted to operational regime and advanced processing algorithms for transients or emergency situations.

Intelligent systems has an increased capacity of failure detection and autodiagnosys and could perform automatic operation evaluation.

Another important feature of digital systems with distributed control is the complex bidirectional communication between reduntant equipments at the same processing level or with upper level (process control level, data management) equipments.

2. SYSTEMS FOR ADAPTIVE FILTERING AND ADJUSTMENT

Modern safety and control systems used in nuclear installations works in complex situations, with a large number of inputs, in different operating scenarios and a large number of optimization criteria.

Principles of intelligent adjustment for filtering and regulating in relation with input data became ineffective in complex installation that require additional criteria to ensure nuclear safety and efficiency in operation.

From the beginning of nuclear industry it was necessary to introduce systems for adaptive filtering and adjustment of reactor power, period, number of circulation pumps that were used, operational regimes of power generators, etc [1].

In this way, we can exemplify with analog and digital systems for adaptive processing that are used in TRIGA Steady State Reactor to measure the neutronic power period $P = (\log N)'$ or "Off core" neutronic power. At low power these systems use 2-nd order filters to process signals with transfer function:

$$G(s) = \frac{T_s}{(1+T_1 s)(1+T_2 s)}, \qquad (1)$$

where T_1 and $T_2 \sim 0{,}25$ seconds

At high power, when 10%<N<105%, those filters are disabled in order to the minimize response time. Also, for N<1% the period scram action is disabled for stability reasons.

Advanced systems perform data quality analysis and automatic adaption of filtering and regulating systems in order to obtain maximum stability and efficiency.

The behaviour of digital systems for adaptive filtering and adjustment depends on data integrity, stability and credibility; data losses in communication channels, differences in information on redundant channels, presence of uncertain values leads to cautious behaviour of these processing systems, increasing the response time.

In this case, the system use a larger amount of data samples, perform a higher order filtering and generates regulating commands more rarely.

The following figure (Figure 1) describe an adaptive system used by the author for neutronic flux adjustment in an irradiation installation through the following algorithm:

$$U_{K-1} = K_R\left(\varepsilon_{K-1} + \frac{T}{T_i}\sum_{i=1}^{K-1}\varepsilon_i - \frac{T_d\left(Y_K - Y_{K-1}\right)}{T} + U_{med}\right) \quad (2)$$

where: $\varepsilon_{K-1} = R_{G(t)} - Y_{K-1}$. (3)

RG(t)- reference produced by the database

KR, Ti, Td, - adjustment coefficients

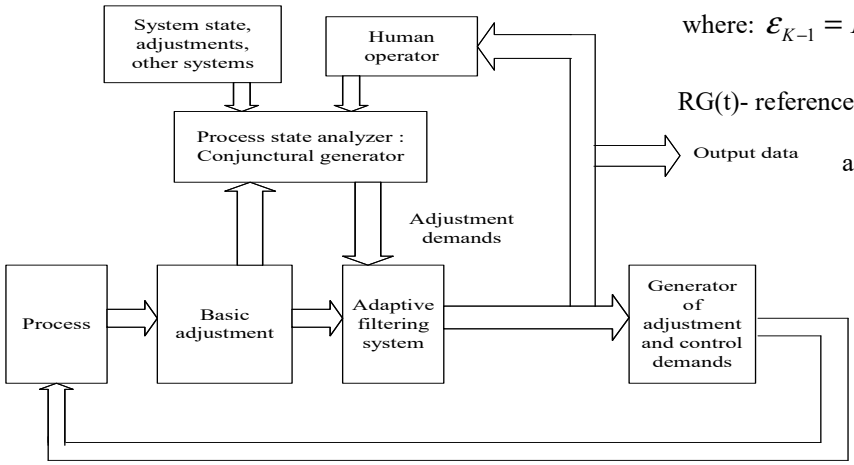

Figure 1 Loopback adaptive algorithm for irradiation process adjustment

The adjustment process could be conditioned by the operator, that could produce anticipated commands caused by planned operations, and by process state analyser, that estimate the working point and neutronic flux steadyness.

An unbalanced behaviour during neutronic power variations produce accomodation acts for reaction rate increasing of adjustment systems and sample rate growing of input. A steady behaviour for neutronic flux produce characteristics changes in adjustment system that ensure a fine tuning and larger sample rate.

Conjunctural adjustments applying ensure balance and a good precision in steady state operation and a quick and sharp response in dynamic regime with controlled flux variations.

Actual requirements for nuclear installation safety and control impose complex systems use that contain hundreds of measurement and control channels, of redundant systems for interlocking and tripping, and of monitoring and data acquisition systems.

Reliability requirements accomplishment for physical systems and for automatic actions is not relying only on redundant voting systems or equipments for parallel data processing.

The frequency of automatic tripping decision owed to simple malfunction have a drastic impact on availability, safe operation, and thus in costs.

Also the lack of real time information on overall state of electronic control systems and on each component lead to assessment capability alteration for maintenance and operation personnel.

By application of autodiagnostic and self-evaluation functions in redundant systems, the safety ”S” and credibility „C” indicators are increasing, but the reliability „R” and availability „A” indicators are decreasing.

A feasible solution for all indicators increasing is to execute autodiagnosys and recovery functions for each operational module.

2.1 Redundant system based on „resource transfer between channels” method

The classic concept of redundant system for nuclear safety presume physical and functional isolation of signal processing and trip channels. This principle, adopted in the ”60 - ”70 has to prevent a major failure propagation (i.e. fire, supply faults, mechanical hazards) to all channels simultaneously.

Modern electronics, based on distributed control, optical data transmission and electromagnetic isolation allow interconnection between redundant channels and physical separation in the same time.

The method of resource transfer in a redundant system allow:

- Input data transfer between parallel data processing channels, in case of individual failure occurence,
- Transfer of processing functions or controls between digital processing units (C1÷C3);
- Transfer of data or programs between local memory units;
- Power supply resources transfer;

Figure 2 below illustrate the implementation of this method in a redundant system:

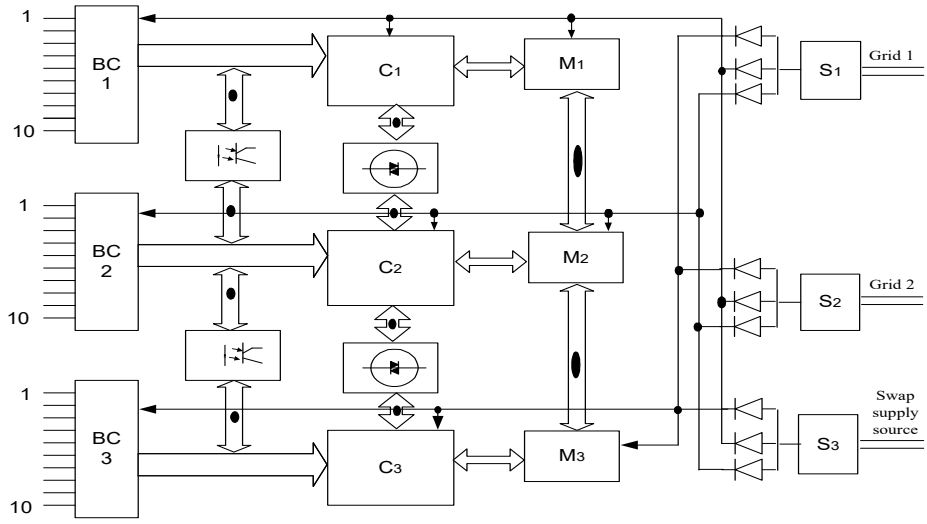

Figure 2 Implementation of resource transfer method in a redundant system

Ci - local controller Mi - local memory block Bci – data processing and conversion block
Si - local supply ● - resource transfer

The realiablity of the system described in Figure 2 is:

$$R_{RTR(t)} = \prod_{i-1}^{n}\left[1-\left(1-R_{i(t)}\right)\right]^{k_i} = \left[1-\left(1-R_{BC(t)}\right)^3\right]\times\left[1-\left(1-R_{C(t)}\right)^3\right]\times\left[1-\left(1-R_{M(t)}\right)^3\right], \quad (4)$$

where:
R_{BC} - Conversion blocks reliability function
$R_C(t)$ - Microcontroller reliability function
$R_M(t)$ - Memory reliability function

Equation (4) accounts for a 100% probability of failure detection and succesful recovery of the system.

Substituting this probability with „c", we can assess a more realistic equation that takes into account of all the reliability parameters implied in keeping in operation of the system:

$$R_{RTR}(r,l,k,\lambda,\lambda_r,t,c) = R_{RTR}(r-1,l,k,\lambda,\lambda_r,t,c) + \int_0^t c^r \frac{d}{dt}\left[1-R_{RTR}(r-1,l,k,\lambda,\lambda_r,t,c)e^{-\lambda}r^2 e^{-\lambda(t-\tau)}d\tau\right], \quad (5)$$

where:
t - operating time
λ - failure rate in isolation mode
r - number of operational modules in hot swap
l - number of failures allowed by the system
K - minimum number of modules in an operational system
c^r - probability of „r" succesful recoveries of the system
$e^{-\lambda}r^{\tau}$ - probability that module „r" (hardware or software) accomplish its function from the moment of enabling until the end of operation.

By using the suggested methods for dynamic recovery and resource transfer may substantially increase the reability of the redundant system; a system like that can be operational with all channel partially failed and using a single power supply.

3. CONCLUSIONS

Actual requirements concerning nuclear installations safety and control involve utilisation of complex structures with hundreds of measurement loops, data acquisition and processing systems, interlocks and tripping systems,

Assuring reliability of physical systems and of automated operation can not be accomplished only by using redundant systems and voting systems.

Figures 3 and 4 exemplifies reliability parameters variation for different reliability configurations using MATLAB simulation tools and reactor operation data.

Obviously, channel multiplication in redundant hardware solutions does not lead automatically to an increase of reliability and safety. Thus, by doubling the data processing lines with 1 out of 2 voting logic, the result is an increase of reactor trip due to false signals (see Fig. 4, case B), while 2 out of 2 logic lead to tripping reliability increase to the prejudice of operational reliability (see Fig. 4, case C). Although, tripping reliability following a channel failure is severely diminished in 2 out of 3 voting logic systems (see Fig. 4, case D).

Figure 4, case A illustrate an example where a single channel system with fail-safe logic has an acceptable operational reliability for simple systems. The downside aspect of this case is the large number of trips due to permanent or temporary failure or due to false signals.

On the other side Figure 4, case E define a situation where the decision reliability is maximized for a three channel adaptive and adjustable system.

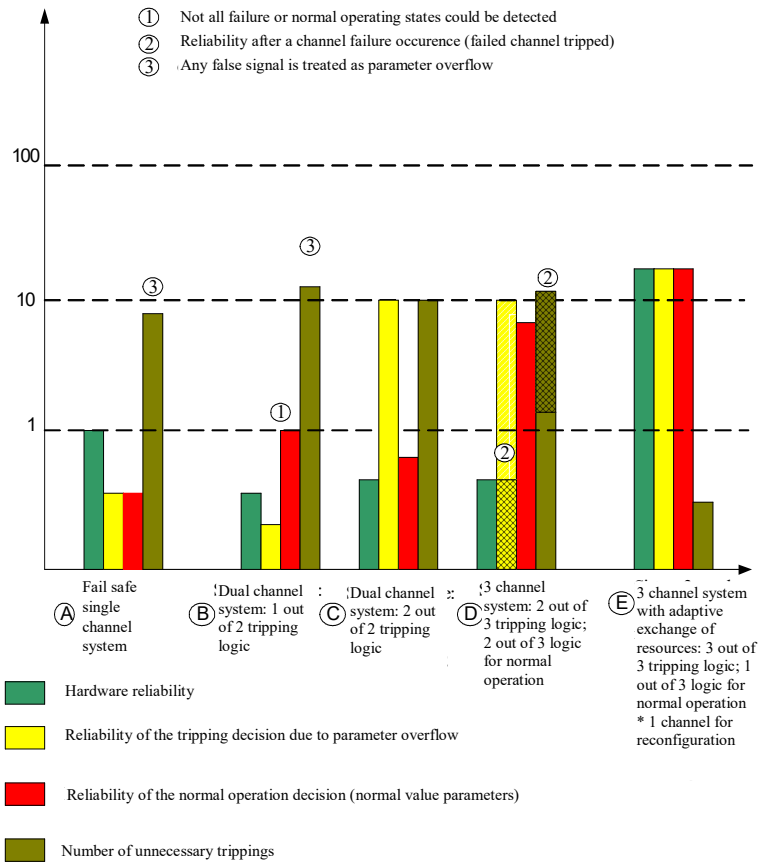

Figure 3 Reliability indicators for redundant systems with operational failures, autodiagnosys and recovery functions

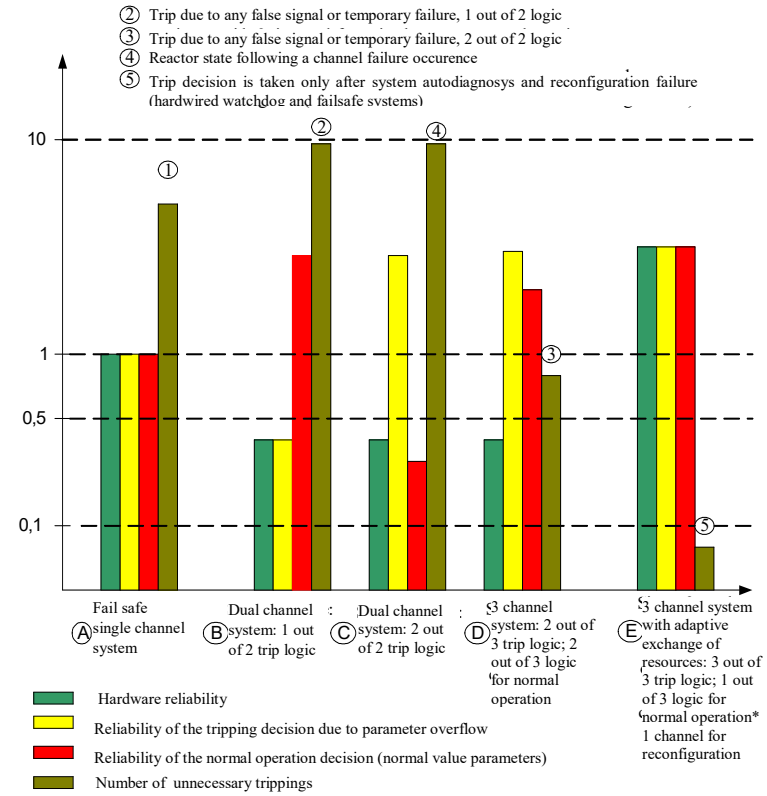

Figure 4 Reliability indicators for redundant systems with autodiagnosys and recovery functions

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SECTION IV
MATHEMATICAL SCIENCES AND PHYSICS

A DECISIONAL MODEL FOR TIMEWORN TECHNICAL EQUIPMENTS

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ABSTRACT

The paper presents some models designed for managing those technical pieces of equipment that present a certain level of wear and tear accumulated during a long period of time.

The precarious operational state of these pieces of equipment can be fixed either through performing maintenance works, or even by disposing the timeworn equipment and replacing it with a more effective and modern equipment. But before its disposal, this equipment can still be used for a certain period of time. The criteria considered in such situations are the effects of the unavailable status of the equipment, plus the associated costs caused by the unavailable status of these pieces of equipment and the discomfort caused by this status. The aim of this study is to highlight the operational degradation – expressed by the alarming entropic level, this fact being as well confirmed by the economic effects of the exploitation of this sort of equipments.

Keywords: *Assessment, linear (non-linear) scale, experton, fuzzy operators, performance function, entropy.*

1. INTRODUCTION

The first issue that makes the subject of this analysis is the identification of the working condition of the equipment considered in this study, by assessing its state probability, completed by its further evolution trend.

The instrument used for this purpose is focused on assessing the state probabilities. Their calculation is based on the „Markov chains theory", and it continues with the assessment of the entropic level, which is alarmingly increasing for certain pieces of equipment.

If two or more pieces of equipment register this destructive trend, the recommended criterion is the economical one. Therefore, the aim of this paperwork is to present the Elmaghraby model used in the economic management of these situations.

2. CASE STUDY

The analysed situation considers two pieces of technical equipment, namely two electrical transformers, 2x25 kVA, which simultaneously operate in order to satisfy the energy demands of the consumers.

Considering the operational state, it is noticeable that the two transformers present levels of wear that cannot be neglected. The manager, the electrical energy provider, has initiated the process of purchasing a 50 kVA transformer, considering, on the long term, to replace the two old transformers with the newly purchased one, which has the same capacity of the two.

Obviously, the new piece of equipment will be operated in ~~an~~ „one out of two" operational conditions.

The aim of this study is to analyse the present operational state condition and the opportunity of using the old equipments, which are to be disposed.

Table 1 is showing the simultaneous time evolution of the two pieces of equipment during 100 days. The operational state~~s~~ are presented using the symbols O (operational state) and F (failure state).

Table 1. The simultaneous time evolution of the two pieces of equipment during 100 days

i	State		i	State	
	T_1	T_2		T_1	T_2
1	O	O	66	O	O
2	O	O	67	O	O
3	O	O	68	F	O
4	O	O	69	O	O
5	O	O	70	O	O
6	O	O	71	O	O
7	O	O	72	O	O
8	O	O	73	F	O
9	O	O	74	O	O
10	F	F	75	O	O
11	O	O	76	O	O
12	O	O	77	O	O
13	O	O	78	O	O
14	O	O	79	O	O
15	O	O	80	F	O
16	F	O	81	F	O
17	O	O	82	O	O
18	O	O	83	O	O
19	O	O	84	O	O
20	O	O	85	O	O
21	O	O	86	O	O
22	O	O	87	O	O
23	O	O	88	O	O
24	O	O	89	O	O
25	O	O	90	O	O
26	O	O	91	O	O
27	O	O	92	F	F
28	F	O	93	O	O
29	O	O	94	O	O
30	O	O	95	O	O
31	O	O	96	O	O
32	O	O	97	F	O
33	F	O	98	O	O
34	O	O	99	O	O
……	……	….	100	O	F

The unavailability of a transformer is compensated by the automated coupling of the new equipment which will function either with the other old transformer or standalone. If both old transformers fail, the new one will be operated at the rated load of 50 kVA.

The analysis of this statistical protocol, given in the table, is highlighting the associated state probabilities of each transformer during the given time interval.

The state probabilities, p_O and p_F, are calculated according to the relations:

$$p_O(\mathrm{T}_k) = \frac{n_O}{n_O + n_F}; \quad (1)$$

$$p_F(\mathrm{T}_k) = \frac{n_F}{n_O + n_F}, \quad (2)$$

where p_O and p_F are the functioning/failure probabilities, and n_O and n_F are the number of days associated to the two states.

Table 2. The calculation of the probabilities corresponding to the present moment

T_k	State			
	O		F	
	$n_O(\mathrm{T}_k)$	$p_O^{(0)}(\mathrm{T}_k)$	$n_F(\mathrm{T}_k)$	$p_F^{(0)}(\mathrm{T}_k)$
T_1	87	0,87000	13	0,13000
T_2	91	0,91000	9	0,09000

In order to determine the state probabilities at a future moment (v) we use the data provided in the table 3 and in the table 4.

Table 3. The transition probabilities for T_1

State		O		F	
		f	p	f	p
O	followed:	74	0,86047	12	0,13953
F		12	0,92308	1	0,07692

Table 4. The transitions probabilities for T_2

State		O		F	
		f	p	f	p
O	followed:	87	0,95604	4	0,04396
F		3	0,37500	5	0,62500

The transition graph from state 0 to state F is provided in Figure 1:

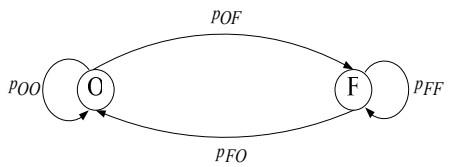

Figure 1 The transition probabilities graph of a technical entity

Considering these transition probabilities, associated to each technical entity:

$p_{OO}, p_{O,F}, p_{FO}, p_{\mathrm{F},F}$ we obtain the following system of equations:

$$\begin{cases} (p_{OO}-1)\,p_O^{(f)} + p_{FO} \times p_F^{(f)} = 0 \\ p_{OF} \times p_O^{(f)} + (p_{FF}-1)\,p_F^{(f)} = 0 \\ p_O^{(f)} + p_F^{(f)} = 1 \end{cases}. \quad (3)$$

where $p_O^{(f)}$ and $p_F^{(f)}$ are the state probabilities at a future moment (f), and the system becomes „probabilistically stable" (ergodic system). [9]

The solving of this system of equations demands building the following matrix:

-the stochastic matrix (of transition probabilities) [3]:

$$[\mathrm{M}] = \begin{bmatrix} p_{OO} & p_{OF} \\ p_{FO} & p_{FF} \end{bmatrix}; \quad (4)$$

- the unit-matrix [I] is considered:

$$[\mathrm{I}] = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}; \quad (5)$$

-resulting the dynamic matrix [D]:

$$[\mathrm{D}] = [\mathrm{M}] - [\mathrm{I}], \quad (6)$$

$$D = \begin{bmatrix} p_{OO}-1 & p_{OF} \\ p_{FO} & p_{FF}-1 \end{bmatrix}. \quad (7)$$

Table 5 provides the state probabilities in present and future moments and also their percentage variations.

We notice that the transformer T_3, whose initial functioning probability ranked it on the first place, also keeps this priority at a future moment.

However, its percentage increase of failure probability of approximately 16,6% indicates an increasing trend of operational decay.

This state is confirmed by the alarmingly increase of the entropic level.

This quantity is calculated using the Shannon relation [2], [3], [4], [8], [11]:

$$H = -\frac{1}{\ln m}\sum_i p_i \ln p_i \quad [\mathrm{bit}], \mathrm{i} = \overline{1;m}, \quad (8)$$

where m is the number of the state of the system.

In the analyzed situation,

$$H = -\frac{1}{\ln 2}(p_O \ln p_O + p_F \ln p_F). \quad (8')$$

Table 5. The probabilities' values in stabilized regime

T_k	Probabilities				Variation (%)		Observations
	Moment (0)		Moment (f)				
	State						
	O	F	O	F	$\Delta p_O^{(-)}$	$\Delta p_F^{(+)}$	
T_1	0,87	0,13	0,8686	0,131	-0.15	+1,01	Slow degradation
T_2	0,91	0,09	0,895	0,104	-1,64	+16,59	Rapid degradation

Table 6. The temporal evolution of the entropy

T_k	H[bit]		$\Delta H(+)$	**Observations**
	Moment (0)	Moment (f)		
T_1	0,55744	0,56102	0,642	Slow degradation
T_2	0,43647	0,48443	10,988	Rapid degradation

An economical analysis of the two equipments gives the manager the possibility to take the optimal decision regarding maintaining or disposing the two old equipments.

The Elmaghraby model [7], [3] can be used for this purpose, offering the possibility to decide the order in which the equipment are to be disposed or kept in operational state for a technically and economically feasible certain amount of time, [10].

According to Elmaghraby model, the disposing order of the timeworn technical equipment is given by the inequality [7]:

$$\Delta c(\mathrm{N}^* - 1) \le 0\,, \tag{9}$$

where $\Delta c(\mathrm{N}^* - 1)$ are the costs associated to these timeworn equipments and N^* is the number of pieces of equipment to be disposed. The costs $\Delta c(\mathrm{N}^* - 1)$ can be obtained from the relation:

$$\Delta c(\mathrm{N}^* - 1) = \mathrm{A}_0(\mathrm{T}) - \mathrm{A}_1(\mathrm{N},\mathrm{T}) + \mathrm{A}_2(\mathrm{N},\mathrm{T})\,; \tag{10}$$

where

$$A_0 = c_0(1 - \sum_k p_k)\,, \tag{10.a}$$

$$A_1 = \frac{\pi N}{\lambda} p_k\,, \tag{10.b}$$

$$A_2 = (\frac{\pi N}{\lambda} - \pi \mathrm{T}) \sum_k p_k\,; \tag{10.c}$$

where,

c_0 are the costs related to the aging and disposing of each old equipment (u.m.);

π are the storage costs adding the maintenance costs (u.m/u.f x u.t);

(u.m.= currency units; u.f=physical units, pieces; u.t= time units.);

N – the number of old equipments;

(λ) –average number of old equipment in functioning state;

T – proposed aging time interval for ~~he~~ the analysis of the evolution in time of the equipment.

The number of timeworn pieces of equipment to be disposed, N*, is given by the maximum amount of costs $\Delta c(\mathrm{N}^* - 1)$, which satisfies the inequality (9).

The behaviour of these pieces of equipment that are rarely used, and which register successive states of functioning and failure is, according to Elmaghraby model, Poisson type, a statistical distribution that is specific to scarce occurring events [5].

We notice:

$c_0 = 4k u.\mathrm{m.}/\mathrm{u.f.}$;

$\pi = 8k\, u.m./u.f. \times \mathrm{u.t.}$,

k is a multiplication factor, and the quantity (λ) is achieved based on the data provided in the table 6;

T={1,2} are the time intervals;

T=1 stands for a time interval of 100 days, T=2 stands for a time interval of 200 days.

Table 7. Statistics outages.

n_{Fj}	**0**	**1**	**2**	$\sum_j$
f_i	76	20	2	100
$n_{F_j} \times f_j$	0	20	4	24

In this table, n_{F_i} is the number of days with no failures, one failure or two failures registered.

So, the medium number of daily failure is:

$$\lambda = \frac{\sum_j f_j \times n_{F_j}}{\sum_j f_j}\,. \tag{11}$$

The probability p_k is obtained using the relation

$$p_k = \frac{(\lambda \mathrm{T})^k}{k!} \times e^{-\lambda T}\,, \tag{12}$$

or according to the recurrence relation:

$$p_{k+1} = \frac{\lambda T}{k+1} p_k\,. \tag{12'}$$

Therefore, we obtain a number of $\lambda = 0.24$ failures per day.

According to the condition (9), the optimal decision regarding the management of the transformers T_1 and T_2 is:

- both transformers will be kept in the endowment of the company;
- after 200 days, one of the transformers will be disposed. It is obvious that T_2 is the one to be disposed, because this one registered the maximum level of entropic state;
- T_1 will be disposed after 300 days.

Obviously, the new transformer T_3 will compensate the failures of the old equipments.

3. CONCLUSIONS

The use of the entropy concept a very important step in the process of assessment of the technical equipment.

The entropic decay level is presenting an image of the wear state of the analyzed technical entity. It is also pointing out the order of disposing ~~for~~ the worn equipment.

The Elmaghraby model, associated with the entropic model, is pointing out the succession of time intervals at the end of which the management can decide

the moment of disposing of those pieces of equipment that, if kept in the endowment of the company, will cause great dissatisfactions, both technical and economical.

4. REFERENCES

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SOME NUMERICAL EXPERIMENTS ON THE APPLICATION OF RELATIVE LYAPUNOV INDICATOR TO SYMPLECTIC AND DISSIPATIVE MAPPINGS

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ABSTRACT

The Relative Lyapunov Indicator (RLI, for short) is a simple and efficient technique that can discriminate with certainty between ordered and chaotic motions in dynamical systems. Based on the evolution of two distinct but very close orbits, it behaves quite different for the two types of orbits. Generally, in the chaotic case the indicator's value increases rapidly in the first few hundreds time steps and then exhibits a slow decreasing or remains constant. On the other hand, the RLI displays a nearly constant value for ordered motions. One of the purposes of this paper is to check how the indicator behaves not only for ordinary regular or chaotic orbits but for other more awkward to assess, including sticky orbits, orbits possessing long transients or characterized by periodic sequences interrupted by short intermittent chaotic windows. Moreover, we want to verify if the RLI realizes a finely distinction between periodic and quasi-periodic orbits. The second goal of the contribution is to provide RLI plots that clearly separate even tiny regions of order and chaos in the phase space or parametric space of the analysed dynamical system. To achieve these, we generate data from the 2D area-preserving standard map and 2D dissipative Tinkerbell map, known for their rich and interesting dynamical behaviour

Keywords: *Order and chaos, mappings, relative Lyapunov indicator, local and global dynamics.*

1. INTRODUCTION

1. INTRODUCTION

A chaos indicator is a tool designed to distinguish between regular and chaotic orbits of a dynamical system. More than thirty such tools there exist nowadays and most of them can be included in two category only. The first one is based on the analysis of a given orbit (like "0 – 1" test, the largest Lyapunov characteristic exponent (LCE), asymmetry coefficients (ACs), fast norm vector indicator (FNVI) or frequency map analysis (FMA)) and the other follows the evolution of deviation vectors from the studied orbit (like the fast Lyapunov indicator (FLI) and its variants $\mathrm{OFLI}_{\perp}^{1}$ and $\mathrm{OFLI}_{\perp\perp}^{2}$, the smaller alignment index (SALI) and its generalization (GALI), the spectral distance (SD) or the mean exponential growth factor of nearby orbits (MEGNO)) [1 – 10].

In 2000, Sandor et al. have introduced another chaos detection method, called the *relative Lyapunov indicator* (RLI). It is based on the evolution of two different but very close orbits and was applied by the authors to some symplectic mappings and continuous Hamiltonian systems [11, 12].

In what follows, after a brief presentation of the RLI, we test its behavior and reliability both on an area-preserving map and on a dissipative map.

2. THE RELATIVE LYAPUNOV INDICATOR. SHORT DESCRIPTION

In this section we briefly describe the *RLI* method for the case of a mapping, following [11]. Consider four objects, namely

- a mapping

$$\mathbf{x}_{\mathbf{n+1}} = \mathbf{M}(\mathbf{x}_{\mathbf{n}}), \tag{1}$$

from $\Re^d$ to $\Re^d$, n belonging to N, and an orbit with the initial condition $\mathbf{x}_{\mathbf{0}}$;

- the tangent map associated to (1)

$$\mathbf{v}_{\mathbf{n+1}} = \frac{\partial \mathbf{M}}{\partial \mathbf{x}}(\mathbf{x}_{\mathbf{n}}) \times \mathbf{v}_{\mathbf{n}}, \tag{2}$$

and an initial vector $\mathbf{v}_{\mathbf{0}}$.

The finite-time Lyapunov indicator (LI) associated to the orbit with initial condition $\mathbf{x}_{\mathbf{0}}$ is defined as

$$L(\mathbf{x}_{\mathbf{0}}, n) = \frac{1}{n} \log \frac{\|\mathbf{v}_{\mathbf{n}}\|}{\|\mathbf{v}_{\mathbf{0}}\|}. \tag{3}$$

The *Relative Lyapunov Indicator* (RLI) measures the difference between the finite-time LI of two neighboring orbits situated at an initial distance $\Delta\mathbf{x}_{\mathbf{0}}$ in the phase space of the dynamical system:

$$RLI(\mathbf{x}_{\mathbf{0}}, n) \equiv \Delta L(\mathbf{x}_{\mathbf{0}}, n) = \left| L(\mathbf{x}_{\mathbf{0}} + \Delta\mathbf{x}_{\mathbf{0}}, n) - L(\mathbf{x}_{\mathbf{0}}, n) \right|. \tag{4}$$

The initial distance $\Delta\mathbf{x}_{\mathbf{0}}$ should be selected small enough to reflect the local properties of the phase space. Sandor et al. proposed the interval $\left[10^{-14}, 10^{-7}\right]$ as a maximal set for choosing $\Delta\mathbf{x}_{\mathbf{0}}$ and demonstrated on a particular case that *RLI* μ $\|\Delta\mathbf{x}_{\mathbf{0}}\|$ for regular orbits while *RLI* is almost independent with $\|\Delta\mathbf{x}_{\mathbf{0}}\|$ for chaotic orbits. Like many other tools (e.g. 0 – 1 test, fast Lyapunov indicator, etc.) the *RLI* shows numerous fluctuations with the number of iterations. They can be eliminated by computing the time average

$$\langle \Delta L(\mathbf{x}_{\mathbf{0}}, n) \rangle = \frac{1}{n} \sum_{i=1}^{n} \Delta L(\mathbf{x}_{\mathbf{0}}, i). \tag{5}$$

This smoothed value is used throughout the paper. As a general trend, *RLI* remains almost constant for a regular orbit, while for a chaotic one it increases rapidly in the first few hundred iterates and then exhibits a slow decreasing or remains constant [12].

3. STANDARD AND TINKERBELL MAPS

3.1. Standard map

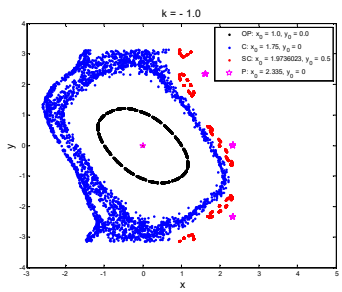
The *standard map*, also known as Taylor – Chirikov map, is a two-dimensional area-preserving map from a square (with side 1 or 2π) onto itself. It represents an exact or an approximate description of many physical systems including kicking rotor, a ball bouncing between oscillating walls, magnetic field lines, etc., and has several mathematical descriptions. In the paper we consider the variant used by Froeschle and Lega [13]

$$\begin{cases} x_{n+1} = x_n + k\sin(x_n + y_n) \\ y_{n+1} = x_n + y_n \end{cases} \pmod{2\pi} \qquad (6)$$

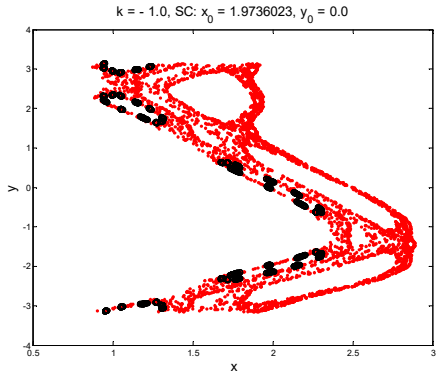
where k is a control parameter that, in the original form, signifies the strength of the kick. The standard map plays the same role for Hamiltonian chaos the logistic map did for chaos in dissipative systems.

As k is gradually decreased/ increased starting with $k = 0$, the map exhibits a transition from order to local and, finally, to global chaos. Without loss of generality we take in the paper k to be negative, a positive k corresponding to a change of coordinates $(x, y) \to (-x, -y)$.

For $k = 0$, the equations (6) are integrable and all the orbits are either periodic or quasi-periodic. The phase plane consists in a set of parallel vertical lines (or tori, with constant x). When $|k|$ is small, the dynamics described above is slightly perturbed in that the vertical tori are curved. Increasing $|k|$, the phase plane shows invariant tori separating different small chaotic regions. Part of the tori are destroyed while several resonances make their appearance. The last invariant tori is destroyed when $|k| \cong 0.971635406$ (Greene's number) and the local chaotic zones merge together to form a large chaotic sea. For $|k| > 2$ the phase plane becomes mostly chaotic, several islands of small size continuing to "survive" (the biggest one being centered on the elliptic point (0, 0)). Finally, for $|k| \cong 2\pi$ transition to global chaos is completed [14].



(a)



(b)

Figure 1 Phase portraits of standard map with $k = -1.0$ and different initial conditions:
a) $x_0 = 1.0, y_0 = 0.0$ (quasi - periodic orbit) ; $x_0 = 1.75$, $y_0 = 0.0$ (chaotic orbit); $x_0 = 1.9738023, y_0 = 0.0$ (sticky-chaotic orbit); $x_0 = 2.335, y_0 = 0.0$ (periodic orbit);
b) The sticky orbit discussed above is plotted for 30000 iterates. After almost 10000 iterates, the orbit reveals its chaotic character (the red points).

For a given k, the orbits may have different behaviours depending on the initial condition. As a typical example, for $k = -1.0$ the orbits starting from (1.0, 0.0) and (2.335, 0.0) are ordered (quasi-periodic and periodic), while those having as initial points (1.75, 0.0) and (1.9738023, 0.0) are chaotic (full or sticky), respectively (see Figure 1). If the number of iterates considered in Figure 1 a) was 2000, to reveal the slow transition towards a chaotic behaviour of orbit with $x_0 = 1.9738023, y_0 = 0.0$, in Figure 1 b) 30000 iterates are plotted additionally

3.2. Tinkerbell map

Tinkerbell map is a two-dimensional dissipative discrete dynamical system given by the difference equations;

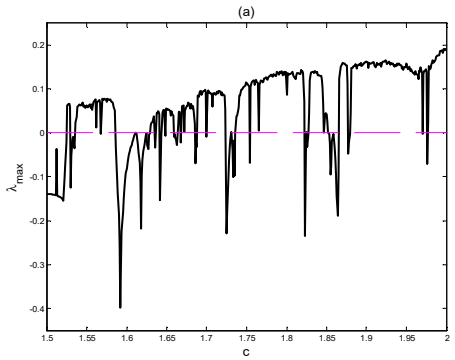
$$x_{n+1} = x_n^2 - y_n^2 + a x_n + b y_n, \quad y_{n+1} = 2 x_n y_n + c x_n + d y_n \qquad (?)$$

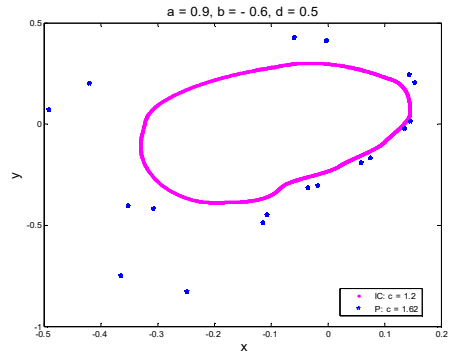
where a, b, c and d are real parameters.

Starting with 1997, the map has been studied for some special cases. It was proven that it exhibits interesting dynamical behaviours, including suddenly appearing and disappearing chaos, interior crises, symmetry-breaking of periodic orbits, coexisting chaotic sets of invariant circles, absence of an obvious road to chaos by period-doubling bifurcation, and so on [15]. Part of these patterns may be obtained by varying c in the range [1.5, 2.0] and fixing $a = 0.9$, $b = -0.6$ and $d = 0.5$ [16].

Figure 2 a) displays the behaviour of the maximum Lyapunov exponent for these parameters. From the diagram, one can easily see a great abundance of periodic windows separated by large chaotic regions. For our purpose of applying the *Relative Lyapunov Indicator*, we selected six different patterns that are presented in Figures 2 b) and c) and Figure 3. Thus, Figure 2 b) displays the phase planes for two ordered

orbits (one is periodic and the other quasi-periodic). Figure 2 c) shows the same indicator for two chaotic orbits. Finally, in Figure 3 we present the time series for a periodic orbit possessing a long transient and for an orbit characterized by intermittent windows of chaotic behaviour.





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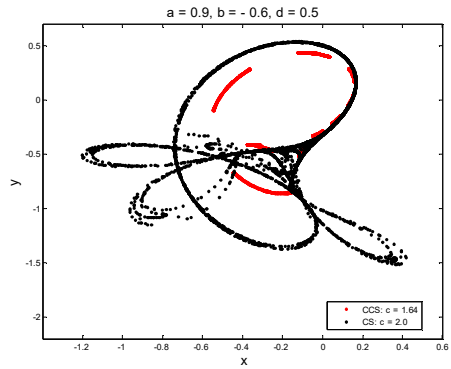
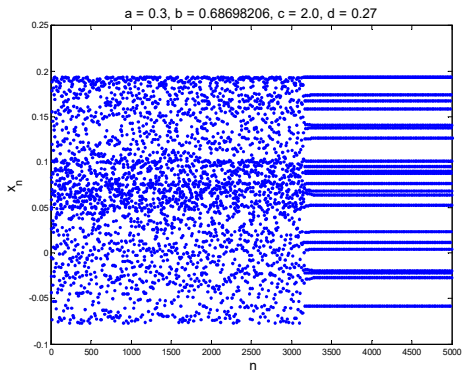


(c)

Figure 2 a) Maximum Lyapunov exponent $\lambda_{\max}$ of Tinkerbell map for $a = 0.9$, $b = -0.6$, $c \in [1.5, 2.0]$ and $d = 0.5$; b) Phase portraits of Tinkerbell map for $a = 0.9$, $b = -0.6$, $d = 0.5$ and $c = 1.2$ (invariant circle) or $c = 1.62$ (period – 18 orbit); c) The same as b) for $c = 1.64$ (coexisting chaotic sets) and $c = 2.0$ (chaotic set).

4. THE BEHAVIOR OF RELATIVE LYAPUNOV INDICATOR FOR PARTICULAR ORBITS

In order to stress the observations included in [12] concerning the behavior of *RLI* for different types of orbits, in what follows we apply the definition (5) with $\|\Delta \mathbf{x}_0\| = 10^{-10}$ for the same orbits discussed in Figures 1 to 3.



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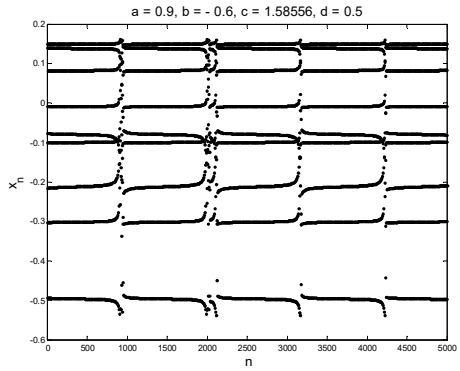


(b)

Figure 3 Time series of Tinkerbell map with:
a) a = 0.3, b = 0.68698206, c = 2, d = 0.27;
b) a = 0.9, b = - 0.6, c = 1.5585556, d = 0.5.

As we can see from Figure 4, obtained for standard map iterated for 20000 time steps, the *RLIs* of the ordered orbits decrease slowly for many thousands of iterates before reaching almost constant values. The final value of *RLI* for periodic orbit is two order of magnitude smaller than that of quasi-periodic orbit (10^{-13} instead 10^{-11}). The *RLI* of chaotic orbit grows abruptly after only 100 iterates, reaches the value $RLI \approx 10^{-2}$ and varies around it for any thousands of iterates. Finally, the *RLI* of sticky orbit shows an intermediate behavior. In the first 2000 iterates, the general tendency is somewhat similar with that of an ordered orbit. Then, the *RLI* starts to increase linearly with the number of iterations and attains the value $RLI \approx 10^{-2}$ after 10^5 iterates.

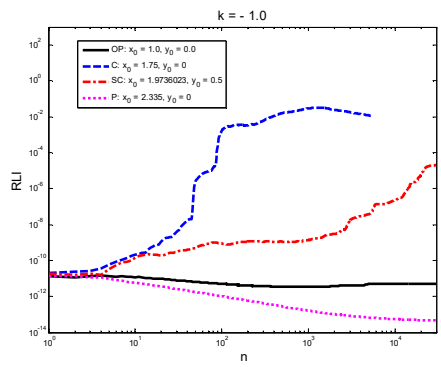
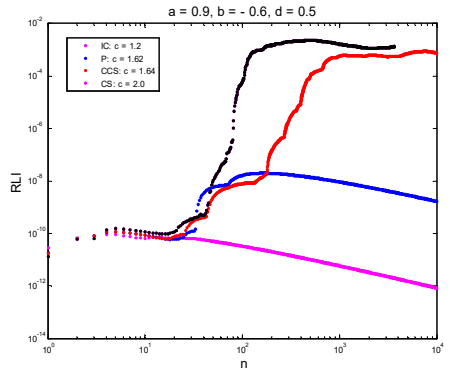
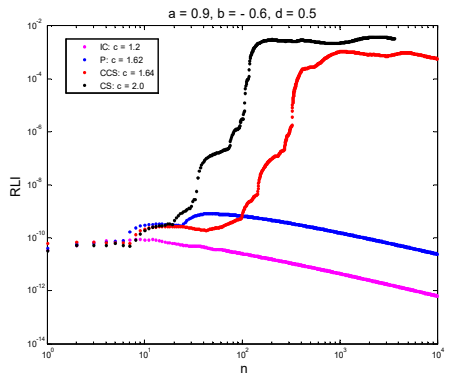


Figure 4 *RLI* vs. discrete time for the four orbits of standard map discussed in Figure 1

In Figure 5, we plot the *RLI* of the four orbits of Tinkerbell map displayed in Figure 2. For a dissipative map, it takes some time for an orbit to approach the attractor (strange or not). This transition period lasts no more than 1000 iterates for the Tinkerbell map. No matter if the first 1000 iterates are discarded as initial transient or they are included in the simulations, the qualitative evolution of *RLI* is the same: a slowly decrease if iterates proceed for an ordered orbit or an abruptly jump to $RLI \approx 10^{-2}$, continued with an almost horizontal landing for a chaotic orbit.



(a)



(b)

Figure 5 *RLI* vs. discrete time for the four orbits of Tinkerbell map discussed in Figure 2.
a) The transient period is included; b) First 1000 iterates are eliminated.

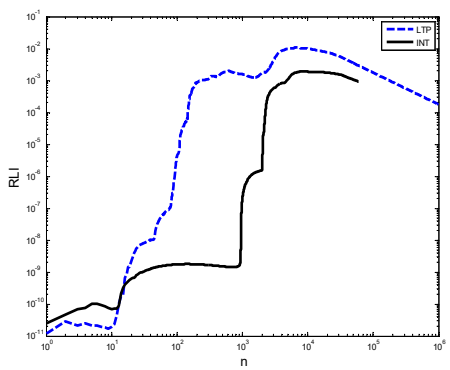


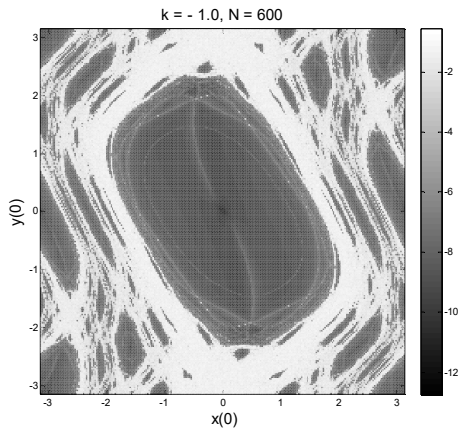
Figure 6 *RLI* vs. discrete time for the two orbits of Tinkerbell map discussed in Figure 3. The dashed and continuous lines stand for the orbits presented in Figures 3a and 3b, respectively.

From quantitative point of view, we remark higher values for *RLI* of the periodic orbit than those for the quasi-periodic one, and some notable differences between the four pairs of curves in the first 100 iterates.

The *RLI* associated to the periodic orbit possessing a long transient (whose time series is plotted in Figure 3a) behaves during the transition as for a chaotic orbit and, after the dynamics has been stabilized, starts to decrease very slowly (its value after 10^6 iterations is just 10^{-4}). For the other orbit in Figure 3, *RLI* "feels" both the ordered and chaotic windows and makes successive jumps from an horizontal landing to another till it reaches a value denoting a chaotic orbit (see Figure 6).

5. THE STANDARD MAP's PHASE PLANE STRUCTURE

In this part, we apply the *RLI* for giving a stroll through the phase space structure of the standard map as it becomes increasingly chaotic. Because of limited space, we present only relevant pictures. They have been obtained for a grid of 251 x 251 = 63 001 equally distributed initial conditions on the square $[-\pi,\pi]\times[-\pi,\pi]$. A coloured little square was assigned to every individual initial condition according to the *RLI* value after *N* iterations. The relationship between the colour and *RLI* value is indicated on a vertical bar near the *RLI* picture.



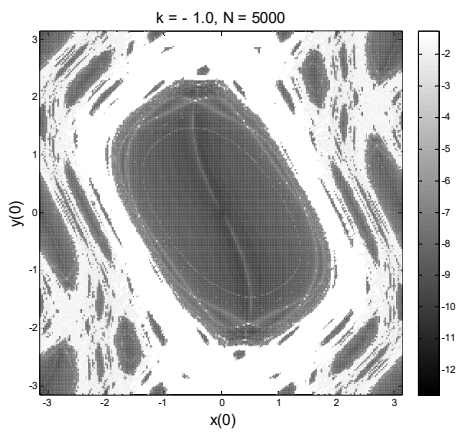
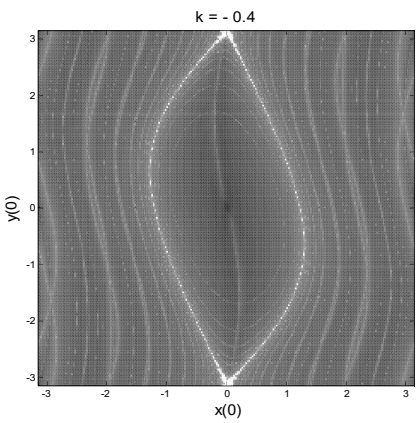


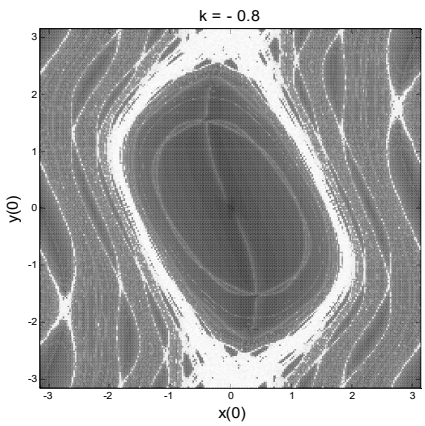
Figure 7 *RLI* plots for standard map with $k = -1.0$. Up: 600 iterations; Down: 5000 iterations.

A first problem to solve was the maximum number of iterations necessary for a reliable separation between order and chaos. A small number may lead to wrong conclusions, at least for the "sticky" orbits, which remain at the borders of an island of regularity for a long time before enter in the chaotic sea. On the other hand, a large number of iterations will require considerable CPU time without yielding additional information. To clarify this, in Figure 7 we show the $\log_{10}(RLI)$ plots for k = - 1.0 and N = 600, respective N = 5000. We observe as when N = 600 in the chaotic sea (the grey zone) an important number of dark points are still present, which seem to describe regular orbits. Additionally, part of grey points may be associated to long transitions toward order or could represent sticky orbits. For $N = 5000$, the colour of the points are mostly white (chaotic orbits) or black (regular orbits) so the distinction between ordered and chaotic regions is unquestionable.

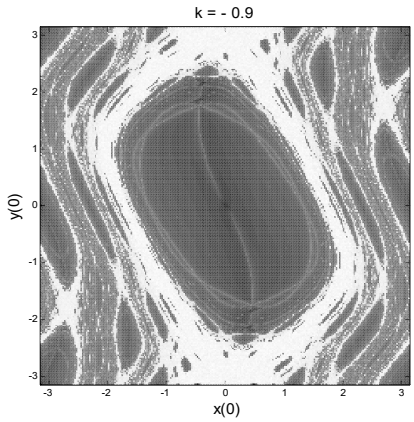
Other *RLI* plots proving the appearance and growth of chaos with increasing $|k|$ are reported in Figure 8. The first sign of chaotic behaviour is revealed by *RLI* in the proximity of the hyperbolic point $(0, \pi)$ (see Figure 6a). For k = - 0.8 or k = - 0.9 the chaotic area is well-developed and make a clear separation between the regular resonant orbits having elliptic shape located around the origin (0, 0), and the surviving regular non-resonant orbits separated by islands of tori. New unstable hyperbolic points are also visible (see Figures 8b and 8c). Once with outrunning the Greene's number, $|k| \cong 0.971635406$, the chaotic zone start to merge and to grow in measure. Apart from the big central island of regularity, a lot of small islands with regular resonant orbits are still embedded in the chaotic region (see Figure 7 for k = - 1 and Figures 8d and 8e for k = - 1.3 and k = - 1.5). For k = - 2.3 only four of these islands have survived and the central island covers less than a quarter of the phase plane (see Figure 8f). Further increases of the control parameter yield to a slowly disappearance of the regularity island, as presented in Figure 9 and Table 1. It is worth noting that, both before and after the Greene's number, the *RLI* "warn" us about the positions into the phase plane where the chaos will "penetrate" the ordered regions (see for example Figures 8b and e).



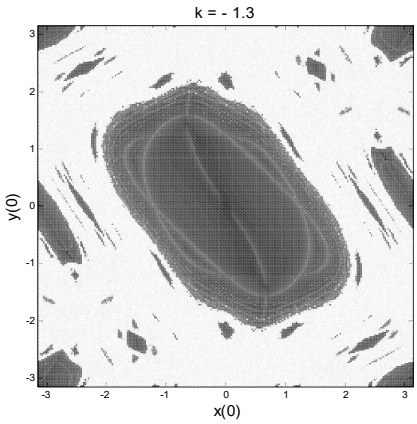
(a)



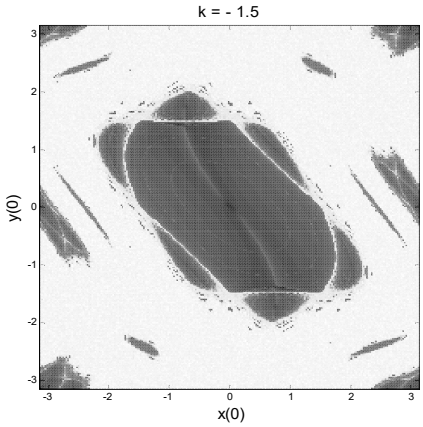
(b)



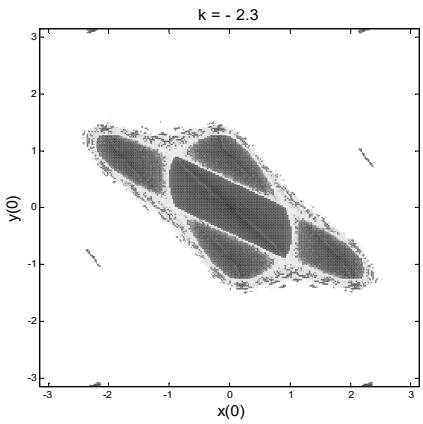
(c)



(d)



(e)



(f)

Figure 8 *RLI* plots demonstrating the growth of chaos with increasing $|k|$

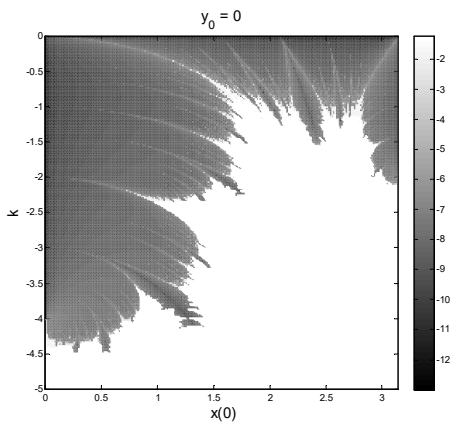


Figure 9 *RLI* plots showing the transition from order (black colour) to chaos (white colour) with increasing $|k|$ on the x – axis of the standard map.

The border between the ordered and chaotic regions shows fractal features.

Table 1. Percentage of chaotic orbits for different k

k	%	k	%	k	%
0	0	- 1.0	26.89	- 2.3	86.75
- 0.3	0.03	- 1.3	60.12	- 3.0	87.68
- 0.8	5.47	- 1.5	69.55	- 5.5	98.03
- 0.9	14.17	- 1.8	73.43	- 6.2	99.29

The orbits used in Figure 1 have been selected from a set of 1000 equally spaced initial conditions on the line $y = 0$, between $x = 0$ and $x = \pi$. For all these orbits, the $\log_{10}(RLI)$ has been computed for N = 2000 and N = 5000 and represented in Figure 10. The two panels are almost identical with some exceptions, generally associated to sticky orbits (some of them are still detectable even for N = 5000).

Well inside the main islands of regularity the RLI values are close to 10^{-13}. They grow slowly to 10^{-10} when one approach the border between ordered and chaotic regions (recall that $|\Delta \mathbf{x_0}| = 10^{-10}$). For all the chaotic orbits, $RLI \cong 10^{-2}$. Finally, for a small island of regularity the *RLI* graph looks like the capital letter V, with the minimum value superposed to a periodic orbit.

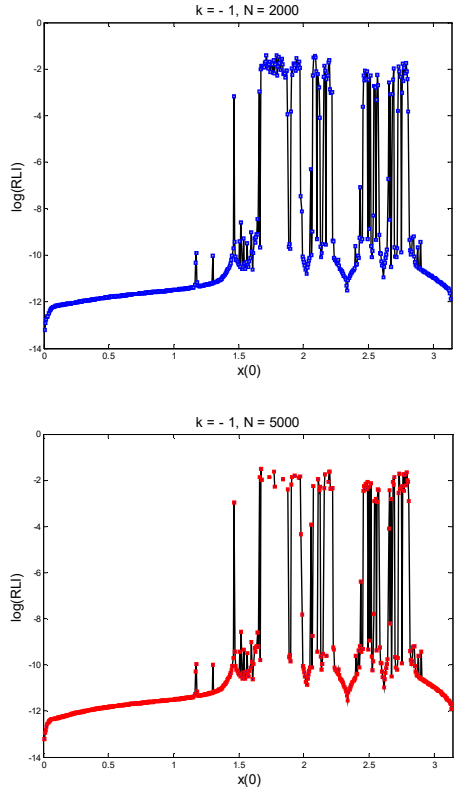


Figure 10 *RLI* values for 1000 equally spaced initial conditions of the standard map with $k = -1$, on the line $y = 0$, between $x = 0$ and $x = \pi$.

Up: N = 2000; Down: N = 5000.

6. THE TINKERBELL MAP's PARAMETRIC ANALYSYS

In the last section, we apply the *RLI* to some large sets of parameters in order to illustrate the distribution of dynamics in the parameter space of Tinkerbell map. First, for the sake of comparison with a consecrated tool and for calibrate the choice for the number of iterations, we reconsider the combination of parameters yielding to Figure 2a.

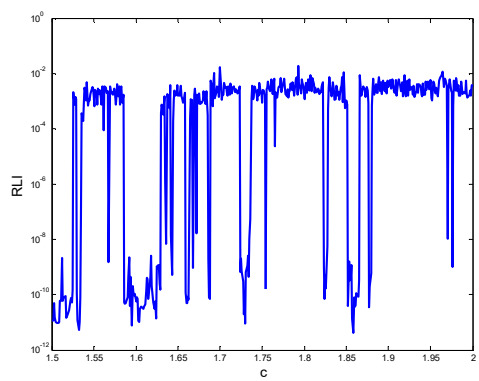
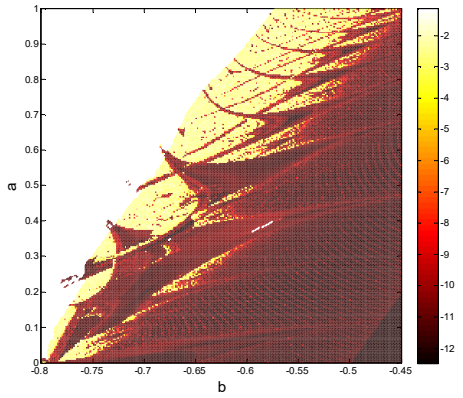
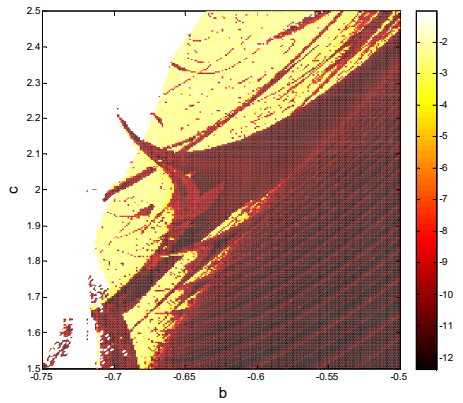


Figure 11 *RLI*'s values of Tinkerbell map for $a = 0.9$, $b = -0.6$, $c \in [1.5, 2.0]$ and $d = 0.5$.

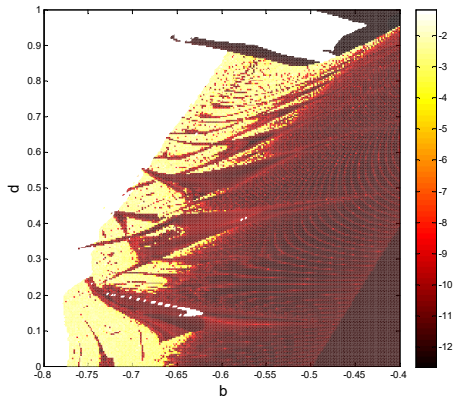
There, from 501 values of c a number of 392 have corresponded to chaotic orbits (positive maximal Lyapunov exponent) if 2000 iterates were used. If the number of iterations has been extended to 20000, then 375 chaotic orbits were recorded. With only 2000 iterations, the *RLI* indicated 370 chaotic orbits, all of which are included among the 375 (see Figure 11).



(a)



(b)



(c)

Figure 12 Dynamical behavior in the parameter plane of Tinkerbell map:

a) $a \in [0,1], b \in [-0.8,-0.45]$, $c = 2$, $d = 0.5$;

b) $a = 0.5$, $b \in [-0.75,-0.5]$, $c \in [1.5, 2.5]$, $d = 0.5$;

c) $a = 0.5$, $b \in [-0.8,-0.4]$, $c = 2$; $d \in [0.0, 1.0]$.

By extending the numerical investigation to a parametric plane, a more interesting dynamical behavior is revealed. We included in Figure 12 three such of plots, corresponding to the parameters plane (*a, b*), (*b, c*) and (*b, d*), respectively. The white area stand for unbounded solutions [15].

7. CONCLUSIONS

In this work, we have shown that the Relative Lyapunov Indicator (*RLI*) is a powerful tool to characterize the regular or chaotic behaviour of orbits in discrete dynamical systems like standard map or Tinkerbell map. The distinction between these two types of orbits is based on the different behaviour of *RLI*. It remains almost constant when one iterate the map for an ordered orbit, while for a chaotic orbit it shows a sharp increase in the first few hundreds iterations followed by a slow decrease or an horizontal landing.

Besides the analysis of some particular interesting orbits, we have presented a sequence of *RLI* pictures showing, on one hand, the dynamical evolution of the standard map from order to chaos as its control parameter is gradually modified and, on the other hand, the mixture of ordered and chaotic regions in the parameters' planes of the Tinkerbell map.

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SECTION V
ENGLISH FOR SPECIFIC PURPOSES

BORROWINGS IN ROMANIAN MARITIME VOCABULARY

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ABSTRACT

Knowledge of the main means of lexis enrichment deserves attention because the richness of a language is primarily given by its variety. It is the generally accepted idea that once language is constituted as an idiom by itself, its development consists in adopting and/or adapting new words. Therefore vocabulary is the most unstable part of language as it is subject to influences from outside, unlike morphology and syntax, which evolve very slowly, giving stability to language. This is true not only to the common language, but also to meta languages, such as that covering the maritime area.

Once the body of words covers all the needs of communication, it is a matter of fair play to find the origins of the newly acquired terms and thus the contributors to the expansion of our mother tongue.

Keywords: *borrowings, communication, intercultural contacts, derivation, transliteration.*

1. INTRODUCTION

In any language words travel and change in two fundamental ways: one external , consisting of borrowings from other languages, another domestic new lexical units that result from combining existing elements in language. As external means of enriching vocabulary , lexical borrowing is an objective fact and it appears as a consequence of linguistic and extra-linguistic factors.

One of the most easily observable results of intercultural contact and communication is the set of loanwords that is imported into the vocabulary of each language involved. The field of cultures and languages in contact (Matras 2009) has grown considerably over the past years, and is likely to continue with ships under 'flags of convenience' and with multicultural crews.

Conventionalization is a gradual process in which a word progressively permeates a larger and larger speech community, becoming part of ever more people's linguistic repertoire. As part of its becoming more familiar to more people, a newly borrowed word gradually adopts sound and other characteristics of the borrowing language as speakers who do not know the source language accommodate it to their own linguistic systems. In time, people in the borrowing community do not perceive the word as a loanword at all. Generally, the longer a borrowed word has been in the language, and the more frequently it is used, the more it resembles the native words of the language.

Researchers found a gold mine in positing a new concept, 'Scale of Receptivity' for languages which more readily accept borrowings. Alongside that scale, a 'Scale of Adaptability' (Hoffer 2005) has been launched. The study of a language's adaptability and receptivity of borrowed words provides some interesting case studies.

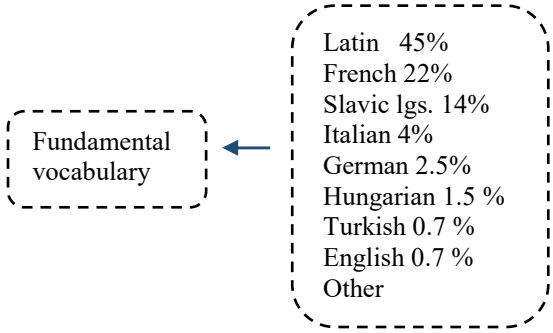
2. FEATURES OF ROMANIAN LANGUAGE

The Romanian language has gone through many periods in which large numbers of words from a particular language were borrowed. These periods coincide with times of major cultural contact between Romanian speakers and those speaking other languages. But these periods are not sharply delimited, and can overlap. The actual process of borrowing is complex and involves many usage events (i.e. instances of use of the new word).

Generally, some speakers of the borrowing language know the source language too, or at least enough of it to utilize the relevant word. They (often consciously) adopt the new word when speaking the borrowing language, because it most exactly fits the idea they are trying to express. If they are bilingual in the source language, which is often the case with people of German and Hungarian origin, they might pronounce the words the same or similar to the way they are pronounced in the source language and in this way they are no longer borrowings, but words shaped on Romanian soil.

Any language consists of two parts: fundamental vocabulary (the most usual words used by all the speakers of that language, and the body of the vocabulary (the specialized vocabulary).

The first part is described in the following diagram:



(www.pixme.org/general)

3. BORROWINGS' ODYSSEY TO THE NEW LAND

In any language words travel and change in two fundamental ways : one external , consisting of borrowings from other languages, another internal, i.e. domestic new lexical units that result from combining existing elements in language . As external means of extanding vocabulary , lexical borrowing is an objective fact and it appears as a consequence of linguistic and extra-linguistic factors.

Romanian maritime vocabulary developed widely after 1877, the War of Independence, when Romanian seafarers could travel the seas without Ottoman control.

The borrowing process is performed by:

a) - zero derivation,
b) - derivation by use of prefixes or suffixes,
c) - parasynthetic derivation (prefix and suffix), and
d) - transliteration.

The language source and number of words will clearly mark the favourite cultural and business partners of the Romanian population of those times.

1. French words

(a)
accoster – acosta (v)
amarrage – amaraj
ambardee – ambardee
accoster.– v. acosta
entrepot – antrepozit (vamal)
armateur – armator
assiette – asieta
babord – babord
balayage – baleiaj
balise – baliza
barbotin – barbotin
bâti – batiu –
bielle – biela –
bigue – biga –
cabestan - cabestan
caboteur – cabotier –
cadet – cadet
cala – cale
calfatage – calafata/calafatui
came – cama
canal – canal
cambuse – cambuza
carène –carena
carré – careu (marinari)
carter – carter
château – castel
quai – chei
quille – chila
culasse – chiulasa
couchette – cuseta
coque – coca
croisière – croaziera
culbuteur – culbutor
courant – curent
coussinet – cuzinet
derive – deriva
dragage – dragaj
dunette – duneta
hélice – elice
épave – epava
étrave – etrava
étambot – etambou
falaise – faleza
fardage – fardaj
filez la chaine – fila lantul
garniture –garnitura
grue – grui
gousset – guseu
gouverner – a guverna
houle – hula
la bord – a borde
lancer (a) – lansa
large (in) – larg
loch – loh
loxodrome – loxodroma
mer – mare
pas– pas (elice)
orthodrome – ortodroma
paquebot – pachebot
patin – patina (la motor)
pétrolier – petrolier
phare – far
à pic – (la) pic
prélart – prelata
rade – rada
rendement – randament
récif – recif
relevement – relevment
remorquer – remorcher
remorque – remorca
resort – resot / arc
roulis – ruliu
safran – safran
sillage – siaj
siflee – siflee
stable – stabila
tangage – tangaj
timonier – timonier
timonierie – timonierie
transatlantique – transatlantic
varangue – varanga
virer – vira
vollier – velier
vireur – viror
vraquier – vrachier

(d)
l'ancre est dérapée – ancora derapeaza
l'ancre est degage – ancora dragheaza
arbre à came – arbore cu came
arbre porte hélice – arbore port-elice
bon état de navigabilité – buna stare de navigabilitate
bouteille d'air – butelie de aer
calme plat – calm plat
(compartiment) machine – camera masini
chargement en vrac – marfă in vrac
jupe du piston – camasa pistonului
double fond – dublu fund
peu stabile – instabila
entrepont – interpunte

livre de bord – jurnal de bord
marchandise en vrac – marfa in vrac
matelot – matelot
mille marin – mila marina
minéralier – mineralier
moteur principale – motorul principal
navigation estimée – navigatie estimata
pas maître de sa manoeuvre – nu e stăpână pe manevră
oeuvre vive – opera vie
oeuvre morte – opera moarta
vent de traverse – vânt de travers
voyage inaugural – voiaj inaugural
bon vent – vânt bun (din pupa)
porte barges – port barjă
port d'escale – port de escală
chamber des cartes – sala hărților
sondeur ultrasone – sonda ultrason
visibilité réduite – vizibilitate redusă

2. English words

The massive loan of Anglo-American terms occurred after WWII in most European languages and was the outcome of the technological progress. It should be stressed that these loans are necessary and influential, even positive, as long as it is a must, and not a 'show off' tendency (Mioara Avram 1997). Loan terms are essential to name concepts, such as management, and other words and phrases that needed coverage in the Romanian vocabulary regarding the naval field.

(a)
allision – aliziune
anchor – ancoră
avarie – avarie
bale – bală
bunker – bunker
cargoboat – cargobot
carrier – cărăuş
channel – canal
coast – coastă
cofferdam – cofferdam
collision – coliziune
container – container
crane – cranic
cyclone – ciclon
displacement – deplasament
dock – doc
ferry(boat) - feribot
gross tonnage – tonaj brut
hub – hub/nod
lash – navă lash
painter – painter
propeller – propulsor
reefer – reefer
ro-ro – navă ro-ro
skipper - skipper
stevedore – stivuitor
stripping – stripare
tanker – tanc
tranship – transfer
unitisation – unitizare
yawl - iolă
yacht - iaht

(d)
accomodations – spaţii destinate cazării
cargo manifest – manifest cargo
clean B/L – conosament curat
deck stringer – stringher de punte
freebord – bord liber
home port – port de domiciliu
length overall – lungime maximă
life boat – barcă de salvare
letter of credit – scrisoare de credit
load line – linie de încărcare
mate's receipt – recipisa secundului
nautical almanac – almanah nautic
offshore rig – platformă marină
radio station – staţie radio
sand bar – bară (de nisip)
sea protest – protest de mare
sea trial – probă de mare
spare tank – tanc de rezerva
stand by - stand by
steering gear – instalaţia de guvernare
tween deck – interpunte
outboard engine – motor exterior
under way – in mars
voyage planning – planificarea voiajului

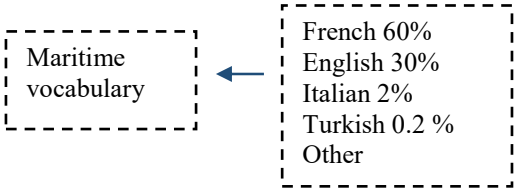
The young maritime officers nowadays are not really interested in the translation since they are part of multicultural crews, and English is the lingua franca of the sea. Therefore, it is no surprise that they adapt English words that are used on board, a language that ensure good communication among multi lingual crews and also a guarantee that they perform their tasks well and keep their jobs, but they use them in everyday Romanian when they retell their sea adventures. For landlubbers of all ages or older sailors who do not speak English well, this mixture sounds like Chinese or any other unknown language.

3. Italian words

mare - marina
nostromo – nostrom
parapetto - parapet
regata - regatta
sagola – saulă

4. Turkish words

(a) arma – arma
hamal - hamal
macara - macara
liman - liman
parampet - parapet
balansina - balansină
remörkör – remorcher



Percentages in the above table are just estimated calculations as only a part of the borrowings have been mentioned and further research is necessary for the exact figures.

4. CONCLUSIONS

Borrowing is a consequence of cultural contact between two language communities. Borrowing of words can go in both directions between the two languages in contact, but often there is an asymmetry, such that more words go from one side to the other. In this case the source language community has some advantage of power, prestige and/or wealth that makes the objects and ideas it brings desirable and useful to the borrowing language community. For example, the Dacian tribes in the first few centuries A.D. adopted numerous loanwords from Latin, more words than the other Romanic languages, as they intensified relationships with the Romans. Few Dacian words, on the other hand, passed into Latin.

In conclusion, the time has seen many Romanian alien elements , who have continuously enriched vocabulary without altering its Latin essence.

The borrowing process of foreign words was very simple because most words are from Romanic languages, so compatibility was not a problem, and only transliteration required some time and skill. That is why the classic borrowing process for the fundamental vocabulary was not necessary, the examples showing that only (a) and (d) were used for producing new words.

There are also words whose origin is yet unknown:

- canarisire
- crivac
- odgon / otgon

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A LINGUISTIC INSIGHT INTO THE NOTION OF LSP

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ABSTRACT

This paper sets to highlight some aspects of language for specific purposes. After a short overview of theories related to both LGP and LSP, we focus on some of the linguistic peculiarities of specialized languages, more specifically, on maritime language. Our aim is to make an analysis of the main theories and debates upon the issue of specialized languages, as the number of articles and writings on the topic is tremendous. We also wish to make a brief presentation of the most important contributions in the domain of LSP. However, we have to admit that the list of authors and articles is much longer, so we had to make a selection, due to the editorial limitations of this paper.

Keywords: *LSP, ESP, maritime language, linguistic features, translation*.

1. INTRODUCTION

LSP does not have an overly long or detailed history in the literature of applied linguistics, and while we can certainly presume that LSP instruction, in some form or other, has existed for as long as language instruction itself, few direct references are made to its practice before Strevens (1977). Even then, much of the research has been solely in the realm of English for Specific Purposes (ESP) instruction. Indeed, the definition of LSP that we favour actually comes from a definition of ESP put forth by Strevens (1988). Language for Specific Purposes (LSP) has been developed to meet the needs of those learners who intend to use language in professional contexts and for professional purposes. Languages for specific purposes, or, in this case, English for Specific Purposes (hereinafter referred to as ESP) can be dealt with from at least two perspectives: on the one hand, from a didactic perspective, as ESP is a sphere of language teaching. On the other hand, we must approach the issue of specialized language(s) from a linguistic viewpoint, as English for Specific Purposes is a peculiar segment of language, with its major component – terminology, to which some authors add the science specific grammar, i.e. linguistic issues and particularities.

2. A DIACHRONIC PERSPECTIVE OF LSP

According to Juliana Garzone (2003: 24) the origin of term *language for specific purposes* appears to be attributed to the French ethnographer and folklorist Arnold van Gennep who, in 1908, used it in the title of his essay "Essai d'une théorie des langues spéciales".
The introduction of the term LSP is also due to Ferdinand de Saussure himself, who used it to refer to "legal language" or "scientific terminology". Nonetheless, regarding the origins of LSP we may also refer to the period of Antiquity when a limited group of people engaged in a certain activity for a long time had to communicate with each other intensively, for instance, early physicians. Latin may be considered as the first LSP which flourished and become the lingua franca in the Middle Ages. Mention needs to be made that when beginning to study a foreign language, people generally learn the LGP of that language. Nielsen (1994: 1) claims that according to the Western linguistic tradition, LGP is the same as a national language, which implies that its entire linguistic system contains all the relevant structures and words used in all varieties, not only occupational, but also regional and social.

On the other hand, *language for specific purposes* is the traditional term for the numerous linguistic variants used in professional settings. The history of the field reveals an entirely theoretical interest in the description of various sublanguages which are assumed to be part of the general language system in response to specific professional needs. The term *sublanguage* was introduced by Harris (1968: 152) who used the term for a portion of natural language differing from other portions of the same language syntactically and/or lexically. Hirschman & Sager changed the definition: "[A sublanguage is] the particular language used in a body of texts dealing with a circumscribed subject area (often reports or articles of a technical speciality or science subfield), in which the authors of the documents share a common vocabulary and common habits of word usage" (Hirschman & Sager, 1982: 28). Early studies of LSP were concerned with the written products, namely specific terminology, text types and register and a significant contribution into the field is attributed mainly to Henry Widdowson (1983), Louis Trimble (1985), Trimble & Trimble (1978); Larry Selinker and John Swales (1971). Thus, Henry G. Widdowson (1983) who was one of the first great contributors to LSP, distinguished between general language and special language courses pointing out that the purpose in LSP is a descriptive term, not a theoretical term, and it "refers to eventual practical use to which the language will be put in achieving occupational and academic aims".

3. DEFINING LSP

Even though LSP definitions are rarer and most research in LSP has been done in the field of ESP, Juliana Garzone (2003: 23) defines languages for specific purposes as "contextual-functional varieties of the language which are usually defined in relation to the

professional, disciplinary or technical field to which they belong" (i.e. maritime industry, economics, medicine, politics, etc.). However, this definition might seems to contradict one of the basic principles of modern structural linguistics, which views language as an organic, autonomous and unitary whole, i.e. a self-contained 'monosystem' which can be described only in terms of the relations and oppositions among the elements that make it up. However, in time there has been a growing recognition of the heterogeneity in the actual realisations of every language on account of its geographic spread, its fragmentation into dialects, its use in literary expression, as well as of the ethnic, political, civil and intellectual history of each nation. *Languages for specific purposes* are also referred to as *domain specific languages, special languages, functional languages, microlanguages* or *technolects, specialized communication, technical English, scientific English, English for special or specific purposes, ESP, English for Occupational Purposes, Professional English or, more recently, Academic and Professional* Language. Nordman (1996: 556) argues that "whenever LSP language refers to different languages linked to different fields, the term *technolect* has also come into use. Specialization in different fields manifests itself in language too, in the form of different technolects of specific fields". She goes on to suggest that "all technolects together constitute LSP in contrast, as it were to general language" (id. ibid.). Engberg (2006: 679) and Nekvapil (2006: 2223) share the view that the term *languages for specific purposes* is multi-faceted and the many facets are a consequence of the fact that this discipline looks at all aspects of actual communication in specialized discursive domains. Engberg (2006) also suggests that the definition of *languages for specific purposes* covers primarily professional areas, but also non-professional areas like hobbies.

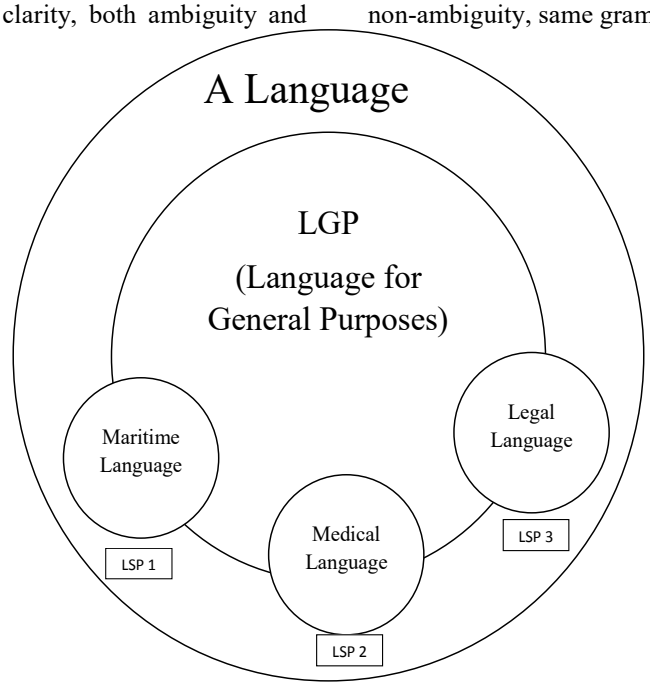
4. THE RELATIONSHIP BETWEEN LGP AND LSP

Bowker and Pearson (2002: 25) suggest that the easiest way to describe LSP is to compare it with LGP. They point out that every language has both LGP and LSP and a native speaker of a certain language is believed to have a very good command of the LGP of that language. Nielsen (1994: 1) argues that "as general purpose language is supposed to be the language that everyone within a speech community knows, it does not seem quite convincing to argue that all language varieties are subsets of an overall general purpose language" (id. ibid), since a lot of ordinary people do not know or understand several of the occupational varieties, both because of their choices of words and their grammatical structures. Language for general purposes (LGP) consists of the language which everyone within a speech community will be able to use and understand on the basis of a shared amount of linguistic and perhaps factual knowledge (id., 1994: 2). In order to determine the relationship between LSP and LGP, consideration should be given to the fact that it is "practically impossible to determine the so-called common vocabulary, to give a complete list of its elements or to classify every word of a language as belonging or not belonging to it" (Hoffman 1987: 298). In this way it is possible to understand common language or LGP in Strevens' terms, that is, the "Language of Specific Purposes of General Communication" (Strevens 1977: 146). Our total language system is made up both of common language and special languages. Croitoru (1996: 79) points out that "*general language* and *special language* may be considered good as working concepts, but there is no clear-cut distinction between them" as regards the (non)existence of rules according to which certain parts of the grammar of English appear in LGP and some others in LSP, e.g. EST. On the other hand, Sager, Dungworth and McDonald (1980: 69 apud. Sager 1994: 44) consider that only the language used by specialists among themselves provides a sufficient theoretical basis for an adequate identification of the distinctive features peculiar to this type of sublanguage. In Nielsen's opinion (1994: 1), languages for specific purposes (LSPs) are also *subdivisions* of the language for general purposes (LGP). In addition, drawing on the definition given by LDAL (1985: 59), *languages for specific purposes* (LSPs) are "languages used for particular and restricted types of communication [...] which contain lexical, grammatical and other linguistic features that are different from ordinary language". In this respect, we consider that it is not these linguistic features that differ from ordinary language, but their degree of occurrence. We also share the opinion that the name itself, that of LSP, involves the existence of LGP, and that special languages are characterized by the tendency to use certain morpho-syntactic patterns which are used with abnormal frequency (Croitoru 1996: 79, Garzone 2003: 26). Picht and Draskau (1985 apud. Cabrè 1999: 66) rightfully consider that a special language can be divided into different levels of specialization, the highest of which corresponds to communication between experts and the lowest to general purpose information meant for the layman: "communication between experts is, as we have seen, only one of the higher levels at which LSP may be used. LSP is also used for the purposes of initiation and instruction, training and development at a lower level of abstraction and specialization" (id. ibid.). From our perspective, special languages are sub-divisions of the language as a whole which interlock with the language for general purposes, with which it shares several features and keeps constant exchange of conventions and paradigms. Our idea is visualized as Figure 1.1 below. The idea has to be reiterated that, the concept of languages for specific purposes and LSP research is generally connected to the teaching and learning of English for Specific Purposes (ESP).

5. LINGUISTIC FEATURES OF LSP WITH A FOCUS ON MARITIME LANGUAGE

An example of specialized language is also maritime language, a language which has gained the status of the lingua franca of the sea. Maritime language is a special type of language used by seafarers and among seafarers and other experts in the maritime industry. Linguistically, maritime language is

characterised by precision, clarity, both ambiguity and non-ambiguity, same grammar, pronunciation and



Figigure 1 Our representation of LSPs

spelling as found in language for general purposes (i.e. LGP), use of symbols, visual symbolization, images and graphs etc. Elena Croitoru (2004) provides a set of criteria peculiar to technical texts, her approach being based on the translation of specialized languages. These aspects can be applied to maritime texts as well. Thus, translating specialized texts is considered to be a process of text taming, which involves both the linguistic analysis of the text and the socio-cultural background. The translation of such texts involves two steps, i.e. decoding the message as a receptor and encoding it for other receptors. Technical translations focus on the first step, as it implies understanding of the peculiarities of technical and scientific discourse, while the latter step involves "the use of adequate terminology, the knowledge of the problems, phenomena, processes, etc. dealt with, and the collaboration with the specialist in the field." (Croitoru 2004: 22). Among the most prevalent linguistic characteristics of LSP, which are also met in maritime language, mention needs to be made of the following:

– Nominative + infinitive constructions with present and past reference, pointing to both simultaneity and anteriority relationship – *the cable is said to be at long stay when it is taut; it proved to have been*; etc.

– Accusative + infinitive constructions with simultaneity relationship: *They consider this type of anchor to be the most efficient → Ei consideră că aceast tip de ancoră este cel mai efficient*;

– verbal adjectives ending in –ed or -ing (eg. *dragged, dragging, moored, mooring, towed, towing, stowed, stowing, veered, veering,* etc.); preposition + gerund and verbal nouns; gerund as a subject (usually translated into Romanian by *prin faptul* că or used after *instead of* and translated *şi nu*);

– passive constructions, which have the highest frequency in maritime language; complex sentences and complex noun phrases;

– use of abbreviations (e.g. DPT, SOLAS OOW, etc.);

– use of the subjunctive mood which is specific to formal English, hence to maritime written texts;

– emphatic use which lays stress on a certain element or comparative sentences and comparative constructions, post-modification rendered by the *–ing* form (*a vessel mooring to the quay* translated into Romanian through attributive clauses *navă care acostează la cheu*), or wh-marked relative clauses (separated by a comma from the main clause), which is also a syntactic peculiarity of maritime texts; linking words that express contradiction, explanation, and conclusion (e.g. *and, although, since, as*, etc.). As far as the vocabulary of maritime language is concerned, it includes much of the vocabulary of general language, though with a large number of specialized items or of familiar words used in a maritime-related context. We shall distinguish between three types of lexems in maritime language texts: a) general language lexical items (e.g. *bow, cat, line, hanger, painter,* etc.); b) specific lexical items that can be attributed to a borderline area between general language and maritime language (e.g. *line, current, etc.*); c) technical terms (i.e. *bollard, acockbill, astern, heaving line, vauxhall,* etc.).

6. LSP RESEARCH TODAY

We have already pointed out that research in LSP is generally connected to ESP research. Research in LSP seems to be more connected to research associated with business schools (for the education of translators), IS (information retrieval, IR), machine translation (MT) and natural language processing (NLP) rather than to pure

linguistic departments. Engberg (2006: 679) identifies two main poles in the area of LSP research, around and between which different approaches and projects are located. The first approach is based on text production in specialized situational settings being linked with language and research of language in relation to the communicative needs of both native and non-native speakers in connection with vocational training, university studies, etc. In this approach attention was paid to creating knowledge about the specific needs to be covered in specialized language classrooms, for making this kind of language teaching as efficient as possible

The second approach in the area of LSP research is more closely connected to the concept of specialized meaning and has a different root. This approach stemmed from the general interest in sociology and dialectology. Mention should be made that modern LSP research is normally not placed at any one of the two poles, but rather at some place on the continuum between them. In addition, there is no one to one relation between countries and approaches.

5. CONCLUSION

LSP is the language used to discuss specialized fields of knowledge which can include everything from professional activities to hobbies, as long as they deal with a restricted subject. On the other hand, LGP is the language used to discuss ordinary things in everyday situations. LSP was generally studied in connection to ESP. LSP refers to the subset of language that is pragmatically characterized by three variables: subject field, type of user, and type of situation in which communication unfolds. LSPs are a subset of the language as a whole, intersecting with the language for general purposes, with which they not only share features but also maintain constant exchange of units and conventions. Our idea was visualized as figure 1.1. The linguistic rules found in LSP are quantitatively greater and pragmatically more specific than those of LGP.

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PECULIARITIES OF MARITIME ROMANIAN TERMINOLOGY AND SOME IMPLICATIONS FOR THE CURRENT TRANSLATION PRACTICE

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ABSTRACT

English is widely regarded as having become the global language. Today it is used for many purposes and it is present in all spheres of life. English is the language of technological and scientific development, trade, maritime industry, media, etc. and it is widely used in everyday conversation as well. Technical vocabulary is most likely to accept foreign words and maritime language is not excluded from this influence. The present paper approaches a few issues related to the features of maritime Romanian terminology nowadays. The first section includes an outline of the representative corpus of terms established to point out the main peculiarities of maritime Romanian terminology, a terminology that is in a continuous process of modernization. From among the peculiarities, attention is also focused on term formation, assignment term-concept with special emphasis on Romanian equivalents and adaptation of Anglicisms, slang terms and expressions. Mention has to be made that the maritime specialists' tendency to combine maritime English with Romanian has given rise to the so called phenomenon of Romglish which is also tackled in this paper.

Keywords: *maritime terminology, term formation, terminological Anglicisms translation procedures, Romglish.*

1. INTRODUCTION

Like all industries, the maritime industry has developed a language and a terminology of its own, which in some cases varies from port to port and specific use to specific use. Yet, linguistic research of maritime terminology is still scarce as there are still relatively few comprehensive terminographic products in the field, even though maritime practice has existed for a long time in our country. Romanian maritime terminology has developed at the turn of the 17th century, the terms being borrowed mainly from French; quite often the English terms, used internationally, are taken over as such into Romanian, and are highly favoured by many maritime specialists. As new maritime-related concepts are born most of the time, there is a specific need of creating proper, precise, accurate Romanian equivalents as a prerequisite to develop the maritime field. This terminology facilitates unambiguous communication, as well as communication mediation among interlocutors using English and Romanian in the maritime professional settings. Our analysis of maritime terminological peculiarities is based on a terminographic product that follows the basic principles of terminology / terminography: a systematic approach based on a rich corpus, thorough analysis of maritime terms, thorough knowledge of the maritime field, a product tailored to include useful information for the main users envisaged (respectively, maritime translators and interpreters, specialists in the field of maritime industry), close collaboration with maritime specialists. The corpus of terms under analysis is also based on several course books delivered at the Romanian Maritime Training Centre (CERONAV), as well as other examples from the consulted documentation.

2. HISTORY OF MARITIME ROMANIAN TERMINOLOGY

An important aspect that needs to be accounted for is the age of our maritime terminology which has taken shape on the basis of the seafarers' language used in the Mediterranean Sea basin and to which there were later added, namely around the middle of the 19th century, some maritime terms pertaining to the Northern Countries (cf. Bejan and Bujeniță 1979). However, the majority of maritime terms are of French, Italian and Latin origin. Mention needs to be made that there has been little linguistic research in the area of maritime terminology, with the exception of a recent study related to the maritime and naval terminology analyzed diachronically by Alina Minea (2007)[1], some earlier studies of maritime terminology that make specific reference to the terminology used in fishing (Sala 1960, Țurlan 1971) and few articles, limited in length focusing on certain maritime terms (Lupu-Babei 1961, Graur 1966), as well as some articles written by specialists in the nautical-maritime domain (Bujeniță 1966). In addition, lexicographic approaches to maritime terminology must be also included here: e.g. Bibicescu (1971), Bejan and Bujeniță (1979), Manole and Ionescu (1982), Beziris et al. (1982), Beziris et al. (1985) and last but not least, a more recent lexicographic compilation entitled *Dicționar Enciclopedic de Marină* (2006) and

[1] In this study the naval maritime terminology in Romanian is investigated from a diachronic point of view. The author investigates the Romanian maritime lexis starting with an analysis of the vocabulary related to ships and crafts used until the 19th century, moving on to the 19th century maritime terminology used onboard warships and merchant vessels and also giving information on the maritime Romanian terminology used during the early, middle and late 20th century. The terminology analyzed refers mainly to the ships' parts, functions and ranks on board, sails, rigging and rope work.

conducted by Anton Bejan. Even though the information included in the aforementioned dictionaries do no longer meet the current requirements, we consider that they still offer an invaluable support for translators and maritime professionals alike, but due to the globalization of the seaborne trade and the introduction of numerous terms of English origin into Romanian, constant updating of these existing maritime dictionaries and the introduction of new fresh lexical material is a prerequisite. Maritime Romanian terminology is still in a full process of restructuring and modernization. Alina Minea (2007: 13) considers that the nautical-maritime Romanian terminology comprises terms related to all types of vessels and types of navigation by water and it can be divided into three sub-terminologies in relation to each type of navigation by water: *maritime terminology* (corresponding to navigation by seas and oceans), *river terminology* comprising terminology related to navigation by Danube and *terminology related to inland waterways*. From our perspective, maritime Romanian terminology can be included in the technical and scientific terminologies, as a sub-variant of the scientific style and developed on the basis of several convergent occupations and activities such as transport, commerce, construction of floating devices, shipbuilding and fishery. In the 20th century, together with the development of science and the modernization of technology, other scientific or technical fields were somewhat assimilated to the maritime domain. There are numerous institutions belonging to the transport field which use maritime terminology in their current activities: ICEPRONAV Galați, the Institute for Research and Design in Transport Technology of Bucharest, the Institute for Land, Naval and Sea Transportation, the national Institute of Research and Development for Maritime Geology and Geotechnology, etc. Maritime Romanian terminology is also used by a relatively large number of ships sailing under foreign flags, but which belong to Romanian ship owners and whose crews are made up of Romanian maritime officers and seafarers[2]. This aspect leads to the use of maritime Romanian on board these ships. As far as the merchant marine and military navy are concerned, both the commercial and military relationships with the Western European countries have been increased as a result of Romania's economic and political reorientation. Military relationships have been also increased due to the participation of Romanian military vessels in several military exercises with the NATO member countries' fleets.

3. MAIN FEATURES OF MARITIME TERMS

Maritime Romanian terminology consists of terms that exist in both literary and popular (folk) language. These terms refer to ships and maritime navigation but they are not restricted only to these two fields, since there are interconnected areas among terminologies as complex semiotic and semi-autonomous systems based on and derived from the scientific style of literary language. An important aspect to be noted here is that maritime Romanian terminology is more and more characterised by lexical borrowing due to the globalization of the seaborne trade. Thus, since Romanian seafarers must use English on board international vessels it is reasonable why a great number of maritime English terms have been absorbed by the Romanian terminology, i.e.: *coferdam* → cofferdam; *container* → container; *a containeriza* → to containerize*; spardec* → spardeck; *stopă* → stopper*; a stripui* → to strip*; surveior* → surveyor; *chilă* → keel, *etc*. According to Alina Minea (2007: 370) the first instance of English influence on the maritime Romanian terminology, was recorded during the first half of the 19th century when the *maritime* term *afterpeak* denoting the extreme aft end of the ship was assimilated by the maritime Romanian terminology. The researcher considers that Maritime Romanian terminology comprises a great part of the general naval terminology including all terms common to the nautical field. Broadly speaking, Alina Minea (2007: 25) classifies these terms into three main categories. The first category she calls the specific category consisting of the following terminology:

a) Terms related to different types of merchant and navy ships and crafts and pleasure boats (e.g. this category also includes names of ships sailing on inland waterways: *barjă* → barge*; cabotier* → coaster*; gabară* → scow; *pescador* → fisherman*; şlep* → river barge*; şalandă* → dumb barge*; şainer* → seiner; *şalupă* → dinghy*; lotcă* → fishing boat; *luntre* → boat/ punt*; iolă* → yawl, etc.. The development of new types of ships has made it possible to coin new terms in Romanian: *navă LNG* → LNG vessel*; navă LPG* → LPG vessel; *navă de croazieră* → cruise ship;

b)Terms related to parts of the ship or craft: *babord* → portside; *bocaport* → hatch cover*; carlingă* → keelson; *covertă* → deck; *copastie* → life rail; *chilă* → keel; *carenă* → quickwork; *dunetă* → poop; *etambou* → stern; *etambreu* → outboard hole*; etravă* → stem; *prova* → bow*; pupa* → stern; *tangon* → boom*; teugă* → forecastle; *tribord* → starboard*; varangă* → floor plate, *sala maşinilor → engine room; punte principală* → main deck, etc.

c) Terms related to functions and naval ranks on board ships: *căpitan maritim - portuar* → harbour/ port master; *căpitan de navă comercială* → chief/ first mate*; secund* → chief/ first mate*; comandant → master/ captain; docher → docker; marangoz → carpenter; marinar brevetat → able-bodied seaman; marinar nebrevetat → rating; motorist → motorman; vardie → watchman; nostrom → bosun; ofițer II punte → second officer / first mate; ofițer III punte → third officer / third mate; ofițer I mecanic → first engineer; ofițer II mecainc → second engineer; pompagiu → pumpman; pontator de marfă → tallyman; electrician maritim → electrical engineer; stivuitor → stevedore; şef mecanic → chief engineer; steward → steward.*

[2] We should mention here the Histria Group Company which encompasses a network of corporate vehicles engaged in ship management, chartering, ship handling, crewing, etc. and which is managed by the former Master Mariner Gheorghe Bos□nceanu. The company was set up in 1992 by a team of maritime professionals, in the wake of liberalization of the Romanian economy and business enterprise.

d) Terms related to traditional and modern means of propulsion (*ramă, velă, fungă, rândunică, velestrai, randă, motor disel, etc.*);
e) Terms related to navigational aids (e.g. *busolă* → magnetic compass; *compass* → compass; *radar* → radar; *sondă ultrason* → echo sounder/ sonar; *sextant*, etc.);
The second category of maritime terms is called the specialized category which consists of terms which consists of terms referring to parts, mechanisms or operations of certain types of specialized vessels: submarines, trawlers, tankers, etc. The last category of terms cited by the author as being part of the maritime terminology is called the common category which consists of terms specific to navigation-related fields such as shipbuilding, geography, astronomy, meteorology, mathematics, physics, astronomy, meteorology, fisheries, telecommunications, etc. In turn, following Cabre (1999) we shall offer a broad classification of maritime Romanian terminology which we divide into technical maritime terms (e.g. terms specific only to the maritime domain); semi-technical terms (e.g. these terms are subject to ploysemy and are created due to the extension of meaning through analogy; they are not restricted only to the maritime field, but they can be common to different special fields); general vocabulary words which are words belonging to the Romanian language stock and which are used in the maritime domain without losing their original meaning (e.g. *a abandona, abandon, a eşua, a lua, a lega, a da, a primi,etc.)*.

The idea has to be pointed out that the specificity of maritime language triggers some interesting linguistic peculiarities. For example, a number of verbs beginning with the vowl *a* are specific only to the maritime field: e.g. *a afurca* - „a ancora o navă folosind două ancore, între care se formează un unghi de 60°- 120°, lanțul filat având aceeaşi lungime pentru ambele ancore, iar distanța între ele – mai mult decât valoarea acestei lungimi" (Manole & Ionescu 1982: 20-21); *afreta* – „a închiria o navă pentru transportul mărfii" (id. 20); *a alimba* „ a debarca o parte din încărcătură şi a o încărca la bordul altei nave, pentru ca nava să se poată deplasa şi în zone cu ape mai mici" (id., 23)*; a ambarda* - „a schimba pe neaşteptate drumul, din cauza acțiunii vântului în rafale, şi a curenților acvatici puternici" (id. ibid.); *a ambosa* – „a menține nava când este ancorată sau legată pe o direcție opusă direcției vântului sau a curentului acvatic, folosind legături sau ancore suplimentare, cum ar fi parâmele, ancoroturile […]" (id. ibid.); *a aprova* - „a se înclina înspre prova şi a rămâne în acestă poziție până se înlătură cauza înclinării" (id., 37), etc. The idea has to be underlined that of the aforementioned verbs, a number of abstract nouns denoting maritime activities and processes have been formed by means of derivation: e,g. *afurcare, afretare, alimbare, ambardee, ambosare, andocare, aprovare, apupare*, etc. In addition, maritime Romanian terminology is also characterised by the use of several transitive verbs which belong to the semantic fields of mooring and anchoring (e.g. *a mola, a fundarisi, a fila, a vira*) and which take several concrete nouns to form field-specific verbal collocations: *a mola parâma, a fila lanțul ancorei, a fundarisi ancora, a vira şpringul/ lanțul de ancoră*, etc. Besides, in mooring and anchoring commands seafarers use certain slang verbs specific to the maritime field: *maina, laşca, fila, funda, vira.* Another feature of maritime Romanian terminology is the constant use of numerous verbal expressions which have *a lua* or *a da* as main verbs (e.g. *a lua drum de… → to set a course/ to steer/ to lay a course; a lua la ureche → to tow alongside; a lua bandă → to heel over; a lua drum de capă → to lay to/ to take trying*; *a da ambardee → to yaw/ to take a yaw; a da bandă → to list/ heel; etc.*). Some maritime terms were borrowed from regional or dialectal variants of the Romanian language. For instance, the term *boț* which is encountered in the Moldavian dialects, is also used in maritime Romanian to denote a"capăt de parâmă sau de lanț ce serveşte la asigurarea unei parâme , unui lanț sau unei ancore" (Bejan and Bujeniță 1979: 50).
In addition, the maritime verb *a mațagoni* whose synonym in Romanian is *a marțagoni* (e.g. a da cu ciocanul (mațagonul) pentru a indeparta rugina) is paralled in English by a verb + noun syntagm, e.g. *to chip rust*, the instrument used to designate the activity performed is *mațagon,* in English, *chipping hammer*. In addition, a number of terms which belong to the Romanian common core vocabulary have entered the maritime vocabulary by means of terminologization. Mention needs to be made of the following examples: *centură → belt; comandă* → bridge; *cuplu (maestru)* → beam; *damă* → rowbed; *nară* → hawse; *perete* → bulkhead; *sfinți* (piese de lemn pentru susținerea bompresului) → knight heads; *stâlpi (de ancorare)* → deadmen; *tablou* → stern board; *travers* → athwartship; *traversă* → breast line. Several maritime terms come from different other fields of knowledge. Therefore, we have found religious terms (e.g. *dom, sfinți, cruce*); terms related to the parts of the body: *inimă, cap, gât, ochi, picior,* etc.; terms connected to animals and birds used in different syntagms to describe different installations on board or certain devices. Some of these terms have perfect equivalents in English, while some are translated by modulation: *gât de lebădă → gooseneck; gheară de pisică → cat's paw; labă de gâscă → bridle; etc.* Another feature of maritime terminology is to employ types of fruit to refer to different maritime concepts: *măr* (e.g. *măr al catargului* → masthead*; măr călăuză* → bull's eye, leading truck, lizard (Beziris et al. 1985: 279); *pară* (e.g. *pară de bandulă* → monkey's fist; *pară de legătură* (la loch) → fish eye, id. 333); *mură* (sail tack; *mură a contrarandei* → gaff-topsail tack; *mură a focului* → jib tack; *mură babord* → port tack; etc.)*; mure*[3] (e.g. *cu murele în bordure diferite* → opposite tacks*), etc.* Thus, some general language words have undergone the process of specialization or narrowing of meaning when used in the maritime domain. Another characteristic of maritime Romanian terminology is the constant usage of abbreviations and initialisms from English (e.g. IMO, STAREC, DPT, OOW, SOLAS, MARPOL, etc.). Other maritime terms are represented by compound adverbs of place or

[3] *Mure* is the plural form of the forest fruit *mură* or *blackberry*, in English. This term is specific to the terminology connected to sailing ships.

compound nouns: *pupa-babord, pupa-tribord, prova-babord, prova-tribord; spargeval de punte,* etc. Several maritime terms and expressions are specific to the Romanian nautical slang. For example, the term ***ajmec*** which denotes a chief engineer assistant is formed by clipping, that is, by abridging the first and last word of the periphrasis *ajutor de şef mecanic*. An important aspect to be noted about maritime Romanian terminology is that it is constantly changing. The differences in jobs specificity on board, has given rise to a so- called 'blind hatred' between the members of deck department and those of the engine room department. As a result, Romanian deck hands have coined several pejorative or slang terms, to refer to the engine-room crew as: *negri, tractorişti, şobolani* or *unsuroşi.* The term *unsuros* is formed by terminological metaphorisation and it is an adjective that defines the function characteristic. The engine room department is also referred to pejoratively as *secţia unsuroşi.* Similarly, the *galley* on board a vessel is referred to pejoratively as *secţia ostropel*. Numerous maritime terms are formed by metaphorical extension. For instance, the term *ancoră* takes on human attributes so that it can become *încălţată, angajată, degajată, liberă* or *curată*. Recent sociolinguistic investigation carried out by Alina Minea (2007: 306- 318) among a group of ten maritime professionals (e.g. seafarers, maritime officers among them) reveals that a number of slang expressions are used by seafarers without being recorded in any of the lexicographic documentation mentioned above: (RO) *a lua ciocane (despre navă)* – a se izbi de navă valuri foarte puternice –(EN) *hammering*; (RO) *a schimba curentul in dragă* – a schimba planurile - (EN) change plans.

4. USE OF ANGLICISMS IN MARITIME ROMANIAN

The maritime domain is gaining more and more new lexical meanings each day. The global influence of maritime trade makes maritime domain one of the richest fields in English neologisms, which is understandable since English has emerged as the main language of the sea. The use of English loans in various terminologies has been selectively analysed. The presence of English lexemes in the Romanian vocabulary was signalled in the studies published in the early 1980s (Chi□oran, 1986 and Hristea, 1984). According to Floriana Popescu (2006: 107) "the presence of anglicisms in specialized vocabularies has been analyzed only against the background of the nautical terminology, the glossary of sports and the language of the press". Maritime Romanian has been influenced directly by various languages belonging to different genetic types, and this has turned Romanian into a generous importer, able to assimilate words from various languages. The impact of various linguistic influences has favoured the openness of our language to borrow foreign words, English words included. In the case of maritime Romanian, its lack of resistance to borrowings (developed throughout the centuries) has proved to be helpful, favouring the integration of English elements. Mention needs to be made that beside the natural need to use some terms coming from English (the influence of English being an international phenomenon due to the progress of some highly pervasive domains), the invasion of maritime English borrowed terms becomes a sort of trend among maritime professionals that frequently and deliberately employ maritime English terms and words, even though these terms may be paralleled by Romanian equivalents (e.g. *sighting ports, plunger, cap washer, crushed wire, gas free, beaching, shore-based personnel*, etc.). This aspect is indicative of
a sort of linguistic "fashion" in the present day maritime domain.

4.1. Maritime borrowings

Lexical borrowings are also called loan words or loans. According to Andrei Şerban (2012) both the form and the meaning of a foreign word become imported (http://romenglish.blogspot.ro/). Semantic borrowing can be subdivided into loan meaning and loan formation. Loan meaning involves the borrowing of a meaning through meaning extension of a word in the target language. The former set of loan words consists of: *deadweight, ferry-boat, manifold, spardeck, trailer, gee, radar, pram, etc.* The latter set is larger than the previous one and it is represented by names of types of vessels or boats, by parts and elements of ships and by denominations of on-shore elements which have to do with shipbuilding. The nouns used to denote parts and structures of vessels as well as onboard and outboard elements include the following examples: *bolard <bollard>, diptanc <deeptank>, doc <dock,* used as a noun), *a andoca <dock,>(* used as a verb), *pic <peak>, afterpic <afterpeak>,* etc. In addition, names of vessels borrowed from Maritime English include: *bric (<brig), brigantină (<brigantine), containier <container>, cliper <clipper ship>, navă lash <lash ship>, outrigger <outrigger>, tramp <tramp>, trauler <trawler>, iaht <yacht>, sea bee < sea bee>, seiner <seiner>, snaip <snipe>, slup <sloop>, schif <skiff, iolă <yawl>*, etc.

4.2. Adaptation

It seems that the general tendency among maritime professionals is to spell the maritime borrowings the same way they are spelt in the donor language. However, the adaptation of the English loanwords is dependent on several factors among which mention needs to be made of the moment of borrowing and the knowledge or by case the ignorance of speakers as regards the English language. The process of adaptation is according to Andreea Varga (2010) hindered on purpose for psychological and socio-linguistic reasons. Besides, we consider that the preservation of borrowings from the maritime field in their original form is produced by their universal usage and their common purpose of communication among maritime professionals. Several types of spelling variants emerge: the etymological spelling, the hybrid spelling and the phonetic spelling:

- *Afterpeak / afterpic – phonetic spelling*
- *Forepeak / forpic – phonetic spelling*
- *Spring / şpring – hybrid spelling*
- *Manifold / manifold – etymological spelling*

- *Pontoon/ ponton – phonetic spelling*
- *Sea-bee/ sea bee - etymological spelling*
- *Container/ container - etymological spelling*
- *Sloop /slup – hybrid spelling*

Thus, as it can be noticed, some orthographically assimilated maritime borrowings are being used nowadays with their original, etymological spelling (the phonetic spelling is replaced with the etymological one), while others are adapted to the Romanian phonetic system.

4.3. Pseudo-maritime borrowings

These are words or word elements in languages other than English that were borrowed from English but are used in a way native English speakers would not recognize. Pseudo-Anglicisms often take the form of blends, combining elements of multiple English words to create a new word that appears to be English but is unrecognizable to a native speaker of English. Examples of such maritime terms are: *boțman <boatman>; coferdam (<cofferdam); cuarterdec <quarterdeck>; pontoon <pontoon>; stabilizatori (<stabilizers>; stringher (<stringer>,* etc.

4.3. Maritime Hybrids

A mixture of lexical and semantic borrowing results in hybrid formations. This process is also called mixed compounds, semi-calques or loan blends, denoting a word or word combination that consists of elements of both source and target language. Sometimes the expression total substitution is used for semantic loans, and partial substitution for hybrid formations. Examples from the maritime field include the following pattern: noun + abbreviation as in: *Convenția SOLAS, navă LPG, navă LNG, navă Ro-Ro, instrucțiuni din MSDS, Regulamente IMO,* etc.

4.4. Maritime Calques

A calque is a form of literal translation. A bad calque imitates ST structure to the point of being ungrammatical in the TL whereas a good calque manages to compromise between imitating a ST structure and not upsetting the grammar of the TL. In radar navigation, the collocation *multiple echoes* is rendered into Romanian by *multiple ecouri* instead of *ecouri multiple*. That is to say, that just like in English, the former structure consists of a plural noun premodified by an adjective instead of a noun post-modified by an adjective. According to Hervey and Higgins (1988: 26) "calquing may also be called a form of cultural borrowing, although, instead of verbatim borrowing of expressions, only the model of SL grammatical structures is borrowed". For example, if ST *true motion* in maritime navigation is rendered in the TT as *true motion* that is cultural borrowing proper, whereas TT *mişcare reală* would be calque. Similarly, if the maritime English '*radar plotting'* in a text on ship's tracking is rendered in the TT as '*radar plotting'*, that is cultural borrowing proper, whereas TT *'plotare radar'* would be a calque. In maritime language a great number of calques belong to the area of navigation, particularly radar navigation as well as to maritime communication. Examples are maritime terms *lungimea peste tot* calqued on the English *length over all*. Other examples are: *blind sector → sector orb; radar shadow → umbră radar*; *target ship → navă țintă; own ship course → drumul navei proprii; target ship course → drumul navei țintă; target ship speed → viteza navei țintă; zero speed point → punctual de viteză zero,* etc .We consider that in using calque as a translation device there are certain dangers that the maritime translator has to cope with. For instance, it can happen that the meaning of the calqued phrases may not be clear in the TT or worst, calques cannot be recognized for what they represent and in this way are merely puzzling the maritime reader.

5. THE ROMGLISH PHENOMENON

Romglish or Romenglish "is the process of combining English with Romanian in normal conversations, with no direct purpose" (http://www.definition-of.com.).

Romanian maritime specialists' use of English on a daily basis in multicultural environments (e.g. on board vessels with mixed nationality crews, in international shipping companies or crewing agencies set up in Constanța, in port, etc.) allowed Romglish to develop as an important part of the maritime language. The maritime-related documentation recently published at CERONAV, has given us the possibility to gather the most recent developments in RomEnglish. Below we have given some examples of maritime English terms used by maritime professionals:

"Aceste spații unde este instalat tancul de marfă poartă denumirea de ***hold space***" (Popa and Martinaş 2014: 13)";

"Compresoarele de marfă sunt de tipul ***oil-free,*** în trei trepte de comprimare, cu piston cu dublă acțiune, marca Sulzer, tip 3k 140-3A " (id. 21);

"***Sloshing*** reprezintă valuri formate la suprafața lichidului din tancurile de marfă datorită mişcării navei" (id., 8).

The occurrence of maritime terms in these documents is evidence that the maritime field borrows, adopts or translates terms so as to provide the necessary information to trainees or other professionals. The most common Romglish words encountered in the support course books delivered at CERONAV reveal the fact that maritime specialists tend to keep the original form of the English element or to adapt the English word to the phonetic, orthographic and morphological characteristics of Romanian. The data collected and analyzed in this paper show a general trend followed by Romanian maritime professionals when dealing with English words from their field. The Romglish phenomenon should not be perceived as destructive, but as a means of enriching the Romanian vocabulary, even though whenever English terms are paralleled by Romanian equivalents, we shall do our best to use them.

6. TRANSLATION ISSUES IN RELATION TO MARITIME TERMINOLOGY

We consider that borrowing words and terms from the maritime source text is accepted as a translation procedure, as long as it is applied judiciously with consideration of the text's readership and stylistic function. Still, we believe that maritime translators' awareness of their role as mediators should lead them to choose a native translation instead of opting for Anglicisms. The textbooks delivered at CERONAV are direct translations from English specialty documentation. The translated texts contain numerous Anglicisms some of them being used to fill a terminological gap, some other being used deliberately. Judging from our results, there is a clear trend among experts in the maritime field to use English loan words. We consider that the tendency to explicate, simplify and conventionalize as translation universals, all have the potential of affecting the maritime translators' decisions to borrow as all three of them favour target language-oriented translations over the item transferred from the source language. An interesting aspect to pursue in the future will be to look beyond lexical borrowing in maritime language and to determine the extent to which language contact in translating affects the target text in terms of transfer of patterns, e.g. syntactic constructs, cohesion, and reproduction of source text repetition.

7. CONCLUSIONS

Maritime Romanian terminology is in a constant process of restructuring and modernization. We have seen that this specialized terminology displays certain linguistic peculiarities (e.g. specific language patterns, use of maritime technical terms, semi-technical words which are subject to polysemy and homonymy, general language words, specialization or narrowing of meaning, use of conversion, derivation and terminologization as a means of enriching the vocabulary, etc.) which make research into maritime language worth exploring and analysing. With the introduction of modern instruments and devices on board merchant vessels, fields such as electromechanics, electronics and informatics have penetrated the general maritime Romanian terminology. We can thus, argue that Maritime Romanian terminology has been structured according to an accumulation of terminologies belonging to various fields, but yet preserving an area peculiar only to the maritime domain. Maritime Romanian and Maritime English as different language pairs may influence the process of borrowing in translation; Romanian is not closely related to English and in combination with the dominant position of English over Romanian, this may increase the chance of borrowing. Not to mention the fact that there is a constant trend among Romanian seafarers to bring home from each international voyage some new fresh lexical material of English origin. Maritime loans are divided into terms which have been adopted in Romanian with their original form and terms which reveal the adaptation of the English element to the phonetic, orthographic and morphological characteristics of Romanian. The data collected and analyzed in this paper reveals that maritime Romanian terminology is more and more influenced by the English element, a fact which triggers some important implications for the current translation practice.

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SECTION VI
TRANSPORT ECONOMICS

CONSIDERATIONS REGARDING THE STRESS OF BRAKE BEAM OF THE FREIGHT WAGONS USING THE Y25 CS BOGIES

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ABSTRACT

The paper proposes an analysis of a brake beam body structure from the freight wagons using the bogie Y 25 Cs. Brake beam makes the connections between brake lever from brake linkage and brake hangers with brake shoes. In other words, brake beam has the role of forward pressure from the brake cylinder blocks and hence the wheel. Brake beam deformation or tear it, due to temperatures, vibrations, shocks, fatigues, faulty brake cylinder then can damage the shoe holder, shoes, wheel or tire damage boxcar derailment. Therefore as additional safety measure to avoid brake beams rails wagon derailment would use safety stirrups. Every time before train departure is required to make evidence brake for braking of the train to note that it is executed in good condition. One of the reasons it can be seen that braking does not correspond to the operating parameters may be due to the brake beams. If the damage cannot fix brake beams in the train case, then there is a risk that the freight wagon can be removed from the train and carried the body to the repair workshop freight wagons, it affects traffic safety.

Keywords: *Brake beam, stress, meshing, finite elements.*

1. INTRODUCTION

Type Y 25 Cs bogies are used in various types of freight cars. Each bogie of this type is equipped with four brake beams, namely brake beams with two axes each wheel. The brake beams are designed to move along with high pressures the brake hangers together with the wheel in horizontal direction, so that the brake shoes do not slide on the wheel.

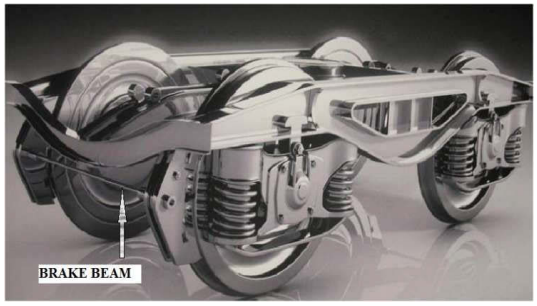

Figure 1 The Y25 Cs bogie with brake beam

Drawing in the figure below was performed using NX Siemens software. In operation, the brake beam is horizontal position as in figure 1. But, in order to be easier remarked, the axes of the brake beam is represented from a different positions such as in the Figure 2.

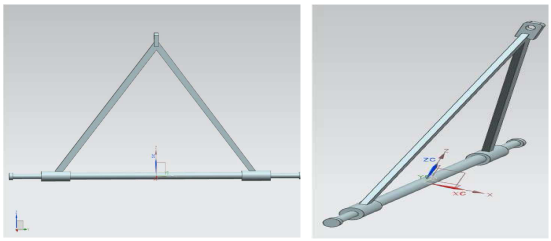

Figure 2 The brake beam

2. THEORETICAL DATA

In this paper we determine the normal stresses according to the theory of the equivalent energy deformation. According to this theory a body limit state is reached when the specific energy deformation equals the specific energy corresponding to the limit state of simple or one axe stretching strain.

The first time I consider a rectangular volume element, which is normally strained on its surface elements by the main normal stresses: σ_1, σ_2 and σ_3.

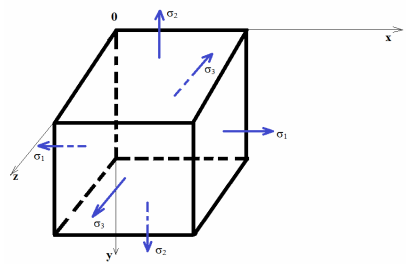

Figure 3 Normal stresses acting on a rectangular volume element

For the case of the linear state, the normal stress according to the Hooke's Law is:

$$\sigma = E \times \varepsilon, \quad (1)$$

where σ is the normal stress, E is the elastic modulus or Young's modulus (for steel ν) and is the transverse shrinkage factor [1].

The strain energy is:

$$U_1 = \frac{1}{2 \times E}\left(\sigma_1^2 + \sigma_2^2 + \sigma_3^2\right) - \frac{\nu}{E}(\sigma_1 \times \sigma_2 + \sigma_2 \times \sigma_3 + \sigma_3 \times \sigma_1) = \frac{\sigma_e^2}{2 \times E}. \quad (2)$$

After simplifications it results the equivalent normal stress:

$$\sigma_e = \sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2 - 2 \times \nu \times (\sigma_1 \times \sigma_2 + \sigma_2 \times \sigma_3 + \sigma_3 \times \sigma_1)} \cdot \quad (3)$$

In the corresponding scientific literature from relation (3), is denoted as it follows:

$$\sigma_{e\,IV-a} = \sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2 - 2 \times \nu \times (\sigma_1 \times \sigma_2 + \sigma_2 \times \sigma_3 + \sigma_3 \times \sigma_1)}, \quad (4)$$

with another notation of this, in other works:

$$\sigma_{echV} = \sqrt{\sigma_1^2 + \sigma_2^2 + \sigma_3^2 - 2 \times \nu \times (\sigma_1 \times \sigma_2 + \sigma_2 \times \sigma_3 + \sigma_3 \times \sigma_1)} \quad (5)$$

The theory of deformation energy which is used for hard materials, remains valid only if the inequality from relation (6) applies:

$$p = \frac{\sigma_1 + \sigma_2 + \sigma_3}{3} > 0, \quad (6)$$

$$p = \frac{\sigma_1 + \sigma_2 + \sigma_3}{3} < 0, \quad (7)$$

But for the case, from relation 7, of the alternative hypothesis of Huber-Mises energy, when only the shape variation energy, namely occurs, the following relation is used [2]:

$$U_{1f} = \frac{1+\nu}{6 \times E} \times \left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right] \cdot \quad (8)$$

For the monoaxial strain state, when it comes to simple compression only, then from the relation (8) only is kept and and thus the shape variation energy at the elasticity limit becomes [1]:

$$U_{1fe} = \frac{1+\nu}{6 \times E} \times 2 \times \sigma_e^2 \cdot \quad (9)$$

Equalizing the previous two relations (8 and 9), the following equality is obtained:

$$\frac{1+\nu}{6 \times E} \times 2 \times \sigma_e^2 = \frac{1+\nu}{6 \times E} \times \left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right]; \quad (10)$$

$$\sigma_e = \sqrt{\frac{1}{2} \times \left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right]} \cdot \quad (11)$$

In the scientific literature from equation (11), is denoted as follows [3]:

$$\sigma_{e\,IV-b} = \sqrt{\frac{1}{2} \times \left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right]} \cdot \quad (12)$$

In other books from the field of study the notation is of the form [3]:

$$\sigma_{e\,IV-b} = \sqrt{\frac{1}{2} \times \left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right]} \cdot \quad (13)$$

3. MESHING AND DEFORMATION OF THE BRAKE BEAM

We carried out a section of the brake beam using the View section command of plane section type, before meshing its body (Figure 4).

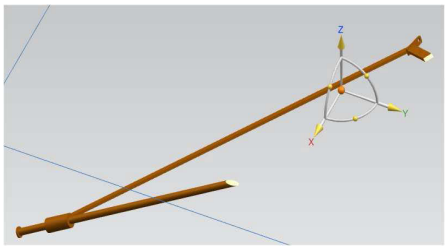

Figure 4 View section command for the brake beam

In order to mesh the brake beam we have used the 3D Tetrahedral Mesh using only triangular elements of 4 mm CTETRA type. For the option of the mesh quality we have chosen to use the midnote method mixed with the max jacobian of 10. For the mesh settings the surface curvature based size is of 50 and the element growth rate is also of 50.

Figure 5 Meshing of the brake beam

In order to determine more easily the von Mises stresses of a brake beam, we use the finite element method from Siemens NX 8.0 software.

The maximum force acting upon brake beam is of 120kN, at the top of it, for a very short time. At the bottom of the brake beam there are two sleeves on which the brake hangers base [4].

At the beginning the whole body of the brake beam (Figure 5) has to be meshed.

After meshing, if the value of the maximal force and the constraints that acting on the brake beam are to be known, then the way how the brake beam distorts can be observed, Figure 6 and Figure 7.

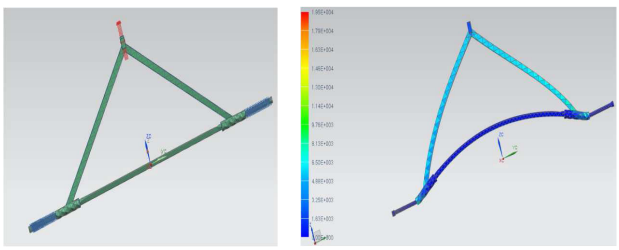

Figure 6 The risk of deformation of the brake beam when it is secured to the brake hanger

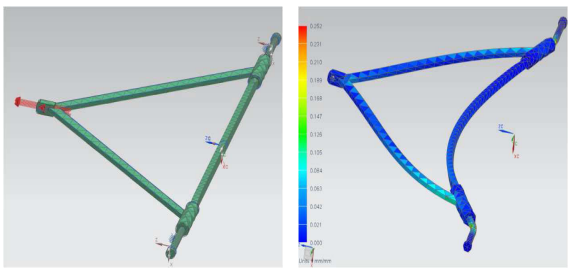

Figure 7 The risk of deformation of the brake beam when it is not secured to the brake hanger

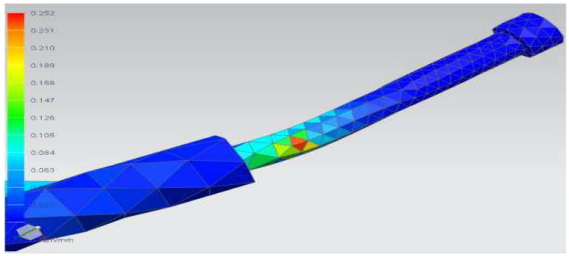

Figure 8 Fracture site of the brake beams determined using the finite element method

Usually the fractures are happening in the section below of the brake beam, because the braking pressures between the brake beam and the brake hanger are very high, figure 8.

4. CONCLUSIONS

An important factor that leads to the fracture is the fatigue of the material. The fatigue is depending on the stress in the body of the brake beam. In the beginning high pressures were applied in the upper section of the brake beam, on the axle box (red coloured), similarly to the moment of braking of the wagon. Besides, it can be observed the uniform distribution of the pressures along the brake beam, figure 9.

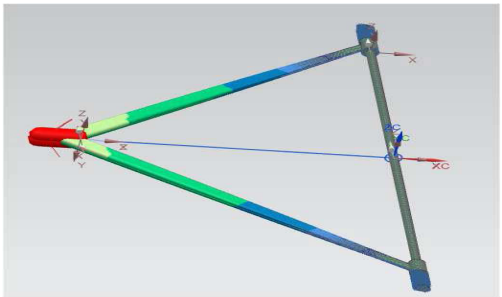

Figure 9 The pressure on the triangular axis

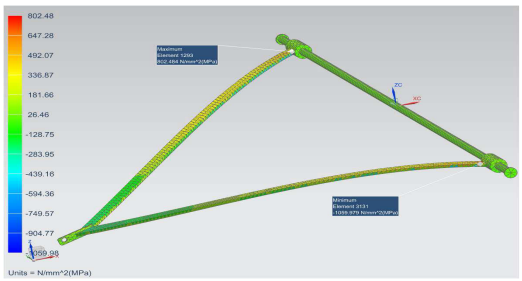

Figure 10 Worst principal stress

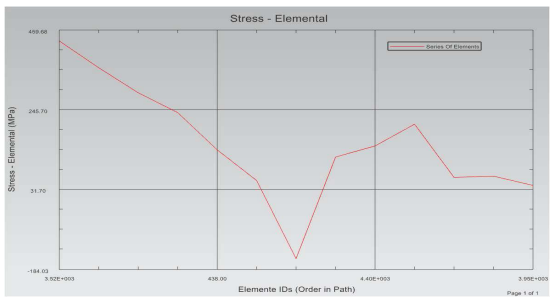

Figure 11 Diagram of worst principal stresses

For the safety of the traffic the worst principal stress has been approached. In the figure it can be observed that the most dangerous stress is in the welded joints. Besides, the same thing it can be also remarked in the annexed chart where high values of worst principal are recorded in the beginning and then these are suddenly decreasing, figure 10.

The main stresses which are born in the brake beam consequently to the strains during the transport at the wagons are: the octahedral normal stress, the von Mises stress, shear stress and normal stress.

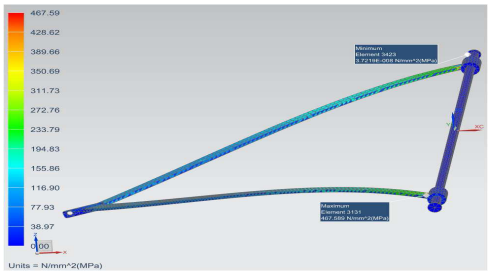

Figure 12 Octahedral shear stress

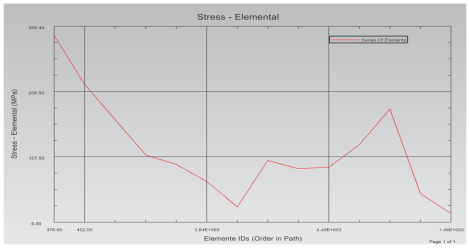

Figure 13 Diagram of the octahedral normal stresses

Although the octahedral normal stress is rarely used, it has a big importance because it contributes to the dilatation strain energy, having the value given by formula:

$$\tau_h = \frac{1}{3}\sqrt{(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2}\,. \qquad (14)$$

Although in the corresponding scientific literature the octahedral shear stress (σ_h) also exists, we preferred in the present paper to analyze only the octahedral normal stress (τ_h), Figure 12.

We can also observe that while the maximal values of the von Mises stresses are in the middle section, the maximal values of normal and shear stresses are at the margins of the brake beam.

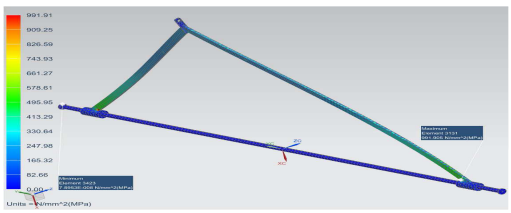

Figure 14 Von Mises stress

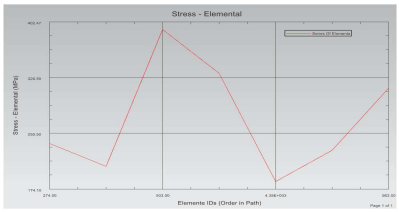

Figure 15 Diagram of the von Mises stresses

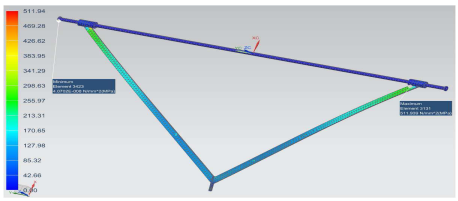

Figure 16 Shear stress

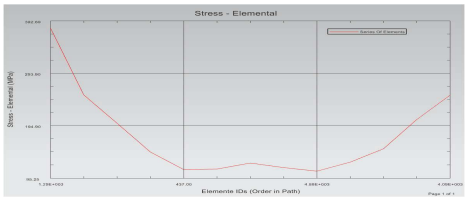

Figure 17 Diagram of the shear stresses

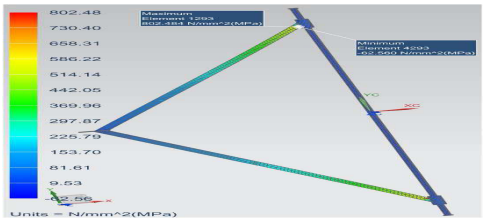

Figure 18 Normal stress

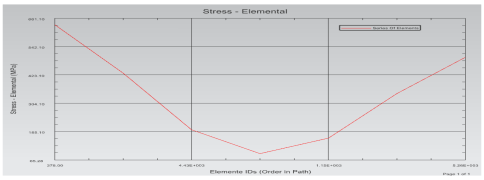

Figure 19 Diagram of the normal stresses

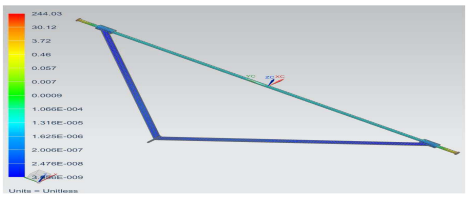

Figure 20 Fatigue safety factor

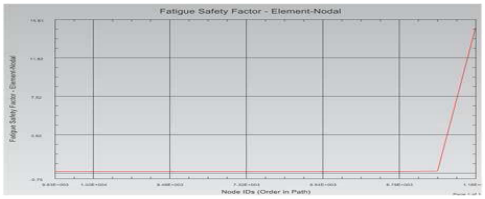

Figure 21 Diagram of the fatigue safety factor

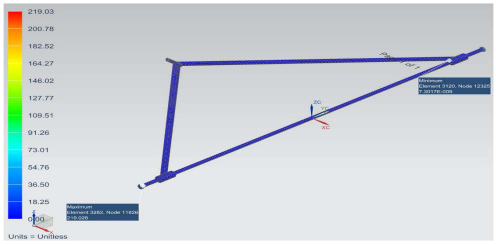

Figure 22 Strength safety factor

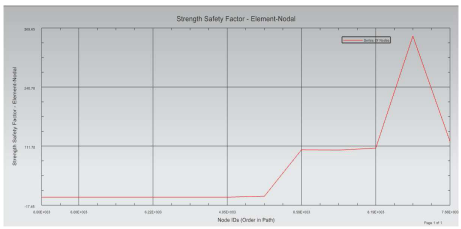

Figure 23 Diagram of the strength safety factor

As it can be seen in the above figures, there is a risk that high forces suddenly acting upon the brake beams to deform them and, and in the worst case, breaking them. The connection between the brake beam and the brake hanger plays an important role in the non-deformation of the brake beam. Due to high shocks, there is a risk of deformation or even breakage of the sleeves of the brake beams, fact causing wear of the wheel.

Thus, it is preferred that the contact between the brake hanger and the brake beam, should be kept as much as possible.

Following the above calculations, it is also not recommended that the sleeves are welded on the dowels of the brake beams because of the fact that high stresses and shocks can break the sleeves of the brake beams.

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ANALYSIS OF SHACKLE PLATES USING THE FINITE ELEMENT METHOD FOR RAILWAY FREIGHT CAR BOGIES FITTED WITH LEAF SPRINGS

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ABSTRACT

The paper presents an analysis of the shackles plates belonging to the railway freight cars fitted with types H or ORE bogies. Shackles plates connect the bogie to the leaf spring. The large displacement or failure of the shackle plate may be produced by temperature variations, vibrations, shocks, fatigues, or large cargo weights. The destruction of the shackle plate may break the main leaf of the leaf spring and it possible to produce the derailment of the railway freight car. The shackle plate's body is subjected to large strains and stresses that may break the piece, therefore an accurate evaluation of the strains and stresses may be done. In practical conditions, once the destruction of the shackle plate is noticed, the locksmith must immediately replace this part which is paramount for the traffic safety.

Keywords: *Shackles plates, stress, mesh, finite elements.*

1. INTRODUCTION

The most utilized railway freight cars are fitted with type H and ORE bogies having leaf springs.

As it can be seen in the figure1 the shackle plate is connected with both, the bogie and leaf spring, as well, by using of shackle pins and scroll iron.

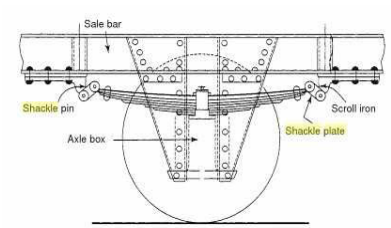

Figure 1 The shackle plate, shackle pin and scroll iron

At the H bogie and the ORE bogie as well, there are 4 pairs on each wheel, so that there is a total amount of 16 shackle plates. The shackle plates can be found in all bogies having leaf springs [1].

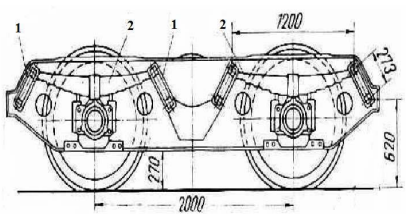

Figure 2 O.R.E. Bogie

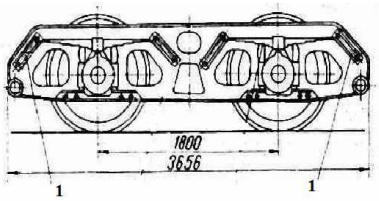

Figure 3 H Bogie
Notations: 1-shackle plate, 2-leaf spring.

2. THEORETICAL DATA

The most vulnerable parts of the shackle plates during their utilization are the top and the bottom of them.

Taking into account that the cross section of the shackle plate is disc shaped, the variation of shear stresses of this cross section is of interest.

For the disc shaped cross section presented in the Figure 4, using the relations between the elements:

$$y = r\cos\varphi, \tag{1}$$

$$dy = -r\sin\varphi d\varphi. \tag{2}$$

The variable breadth of the surface element is:

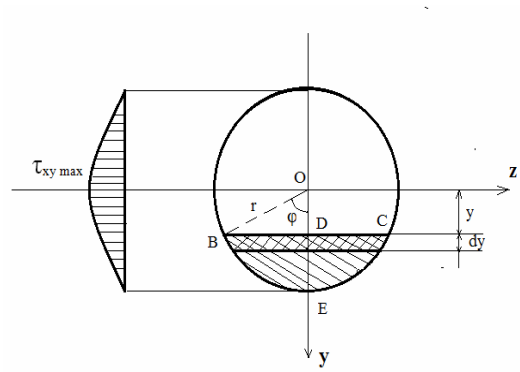

Figure 4 The variation of the shear stresses for the disc shaped cross section

$$b = BC = 2r\sin\varphi. \tag{3}$$

The first moment of area, hatched area which is namely a surface integral with the surface of the area element being ($dA = b \rangle dy$). It follows:

$$S = \int_{\varphi}^{0} ydA = -\int_{\varphi}^{0} r\cos\varphi 2r\sin\varphi r\sin\varphi d\varphi . \quad (4)$$

This integral is calculated by varying y from OD to OE, the corresponding angle thus varying from φ to (4). By inverting the limits of the integral and thus the sign of the integral at the same time as well [2].

$$S = \int_{0}^{\kappa} 2r^3 \sin^2\varphi\cos\varphi d\varphi = \frac{2}{3} r^3 \sin^3\varphi . \quad (5)$$

The second moment of area of the disk shaped surface is:

$$I_z = \frac{\pi d^4}{64} = \frac{\pi r^4}{4} . \quad (6)$$

By replacing the known values in the Juravski relation, which is namely [3]:

$$.\tau_{xy} = \tau_{yx} = \frac{T \rangle S}{b \times I_z}$$

(7)

So that,

$$\tau_{xy} = \frac{T \times S}{b \times I_z} = \frac{T\frac{2}{3}r^3 \sin^3\varphi}{\frac{\pi r^4}{4} \times 2r\sin\varphi} = \frac{4T\sin^2\varphi}{3A} \quad (8)$$

The law of variation for the shear stress τ_{xy} is that of the function sin2φ. Consequently the shear stress is null in the extremes and maximal on the neutral axe (when φ=π/2).

The conclusion is that the maximal shear stress ($\tau_{xy\,max}$) has the value:

$$\tau_{xy\,max} = \frac{4}{3} \times \frac{T}{A} . \quad (9)$$

3. ANALYSIS OF THE JEOPARDIZED AREA OF THE SHACKLE PLATE

The aim of this work is to analyse the behaviour of the shear stresses, only in the most deformation strained which is also the breakage most exposed area of a shackle plate, with the shape of a bar having disc shaped section.

The shear stresses are to be calculated using the finite element method using the NX Siemens software. In order to mesh the analysed body (Fig. 8 and Fig.10), elements of volume of 10 mm (CTETRA10) are being used.

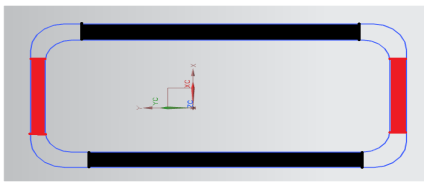

Figure 5 The jeopardized areas of the shackle plate

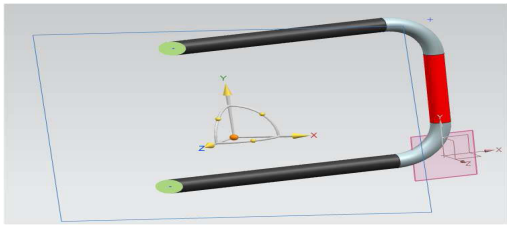

Figure 6 Sectiunea lui shackle plate

In order to see better the stresses of the shackle plate we have carried out the section analysis from Figure 7.

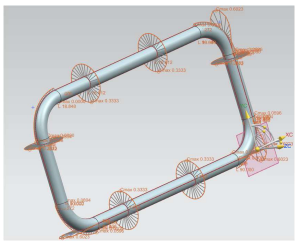

Figure 7 Section analysis of the shackle plate

Jeopardized areas:

1) The red area – the area exposed to bending.
2) The black area – the stretching strained area.

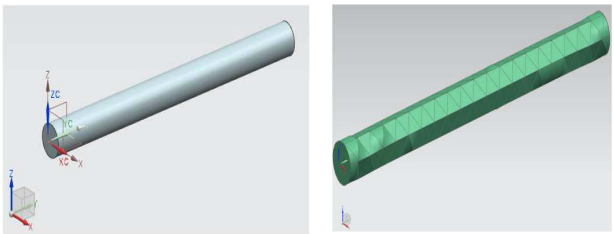

Figure 8 The jeopardized area of the shackle plate together with its meshing (red area)

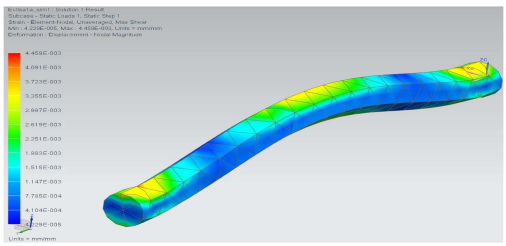

Figure 9 Deformation of the shackle plate in the red area

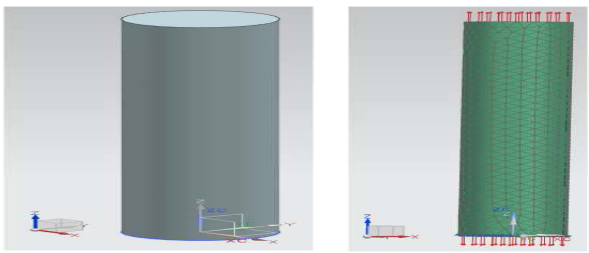

Figure 10 The jeopardized area of the shackle plate together with its meshing (black area)

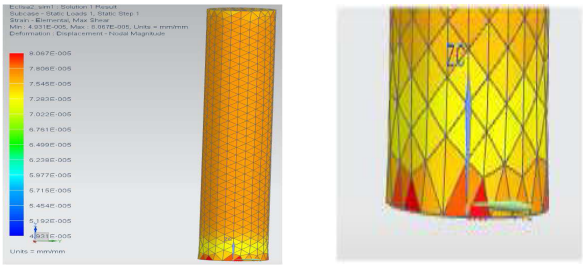

Figure 11 Deformation of the shackle plate in the black area

3. CONCLUSIONS

The pressures in the shackle plate are very high in the frontal section (red area), especially when the wagon is high loaded, that is why we considered the stresses and fatigue in the body of the shackle plate [4].

We are meshing thus the whole shackle plate, Figure 12.

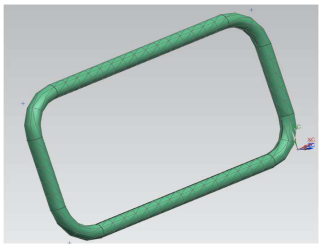

Figure 12 Meshing of the shackle plate

Afterwards we apply the pressure (red coloured arrows) and the embedding (blue coloured), Figure 13.

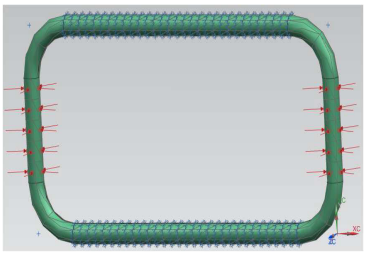

Figure 13 Pressure and embedding in the shackle plate

We begin by determining the normal stresses, Figure 14.

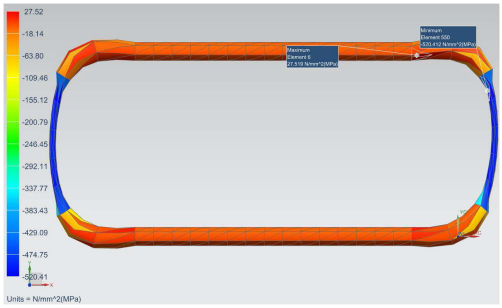

Figure 14 Normal stresses

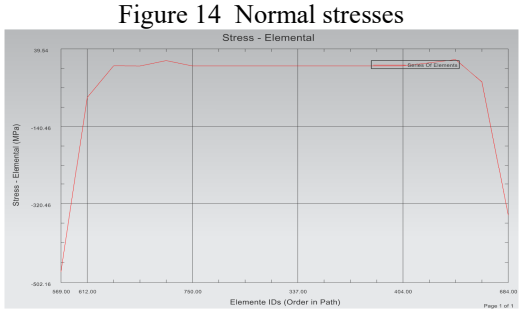

Figure 15 Chart of the normal stresses

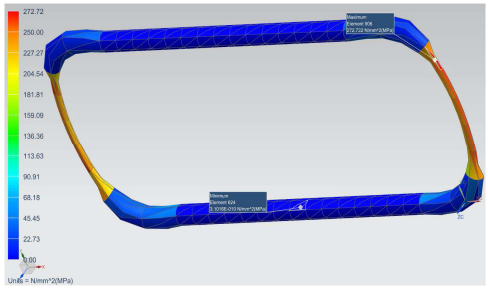

Figure 16 Shear stresses

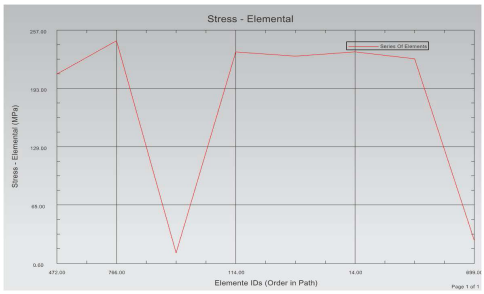

Figure 17 Diagram of the shear stresses

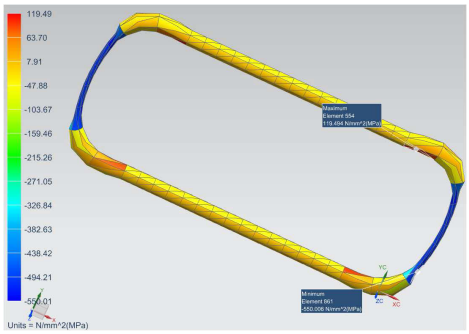

Figure 18 Worst principal stresses

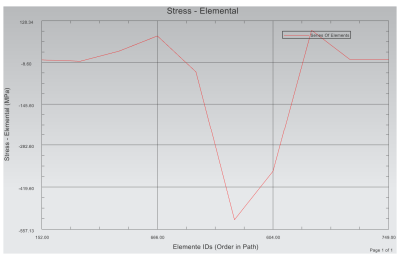

Figure 19 Diagram of the worst principal stresses

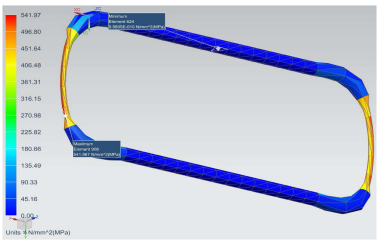

Figure 20 The von Mises stresses

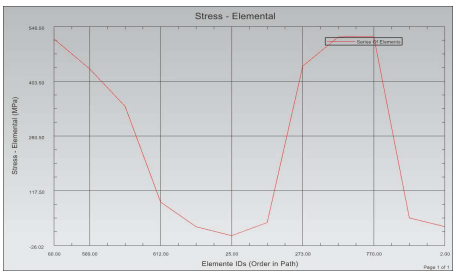

Figure 21 Diagram of the von Mises stresses

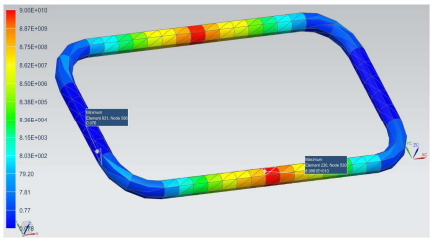

Figure 22 Fatigue Safety Factor for shackle plate

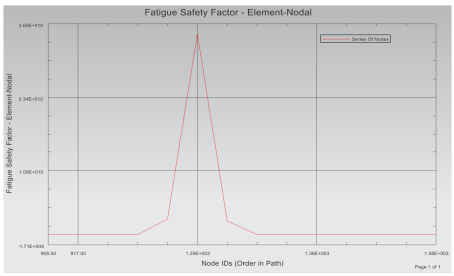

Figure 23 Diagram of the fatigue safety factor

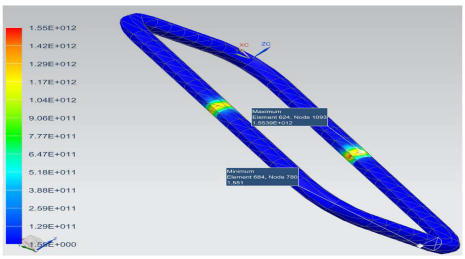

Figure 24 Strength Safety factor

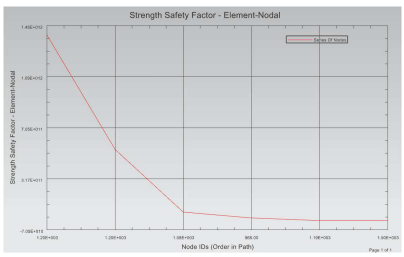

Figure 25 Diagram of the strength safety factor

It can be remarked that the normal stresses are higher in the lateral of the shackle plate (black area), the shear stresses and the von Mises stresses are higher in the frontal area of the shackle plate (red area). But the worst principal stresses which are affecting the quality of the shackle plate are higher in the corners of the plate.
Regarding the Fatigue Safety Factor and the strength safety factor, the maximal values are lying in the middle sections of the black areas, thus indicating a high wearing of the shackle plate, which can cause the tearing of the plate, in its middle section.

Consequently to this paper we are representing the opinion that the trial test for the shackle plates, has to be performed for a pair of shackle plates, bearing in mind the fact that if a shackle plate breaks, the way in which the other one takes over the stresses should be observed. On this trial test stand, the shackle plates have to be strained by high shocks, in order to observe the behaviour of the shackle plate, especially at sudden braking of the train [5].

Although in many of the Romanian scientific literature books, the shackle plate is almost disregarded, as compared for example with the springs or the axles, we deem that for security reasons of the transportation by train, this part plays also an important role, being at least so important as the previous mentioned two parts.

That is why we consider that at the periodic inspections performed on the railway freight cars, the shackle plates have to be also obligatory checked on trial stands.

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MARITIME TERRORISM – IMMINENCY OR ASSUMPTION

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ABSTRACT

Globalization and internationalization are nowadays trends which offer important opportunities for business development. An indicator of the global economy may be considered the maritime transport, the economic crises leading to a smaller volume of commodities transported by ships. Apart of the opportunities, the globalization of the hazards and vulnerabilities require a higher degree of awareness. Ships' security is an important actual concern, being implemented sets of protective measures, such as procedural, legislative, IT and integrated measures. The goal of these measures is to prevent or to minimize the effects of the terrorist attacks. From this standpoint, the maritime terrorism is a particular form of the international terrorism and an unwanted side effect of the globalization. To have an accurate representation of the maritime terrorism, we analyze this phenomenon in comparison with the piracy and the theft at sea. These illegal actions are incriminated by the same legislative documents, but they are based on other visions, purposes and methods in comparison to the so called 'classic' terrorism. The paper is an attempt to bring together the most important concepts and facts regarding the maritime terrorism in the actual globalization conditions of the terrorism.

Keywords: *terrorism, security, risk, strategic policy.*

2. INTRODUCTION

On 13/11/2015, France, Belgium shortly afterwards, faced with Islamic terrorist attacks motivated, which is why today, on their territory are implemented specific measures as a state of exception. They involve gradual limitation of rights and freedoms, some regions are in maximum alert (alerte ATTENTAT), the others remaining in a state of attention (VIGILENCE).

The real reason of the attacks is reflected in the colonial history promoted in North of Africa, deployed military support abroad (Mali), political and logistical support for coalition against the Islamic State. Targets hit have symbolic value, being negatively influenced people's sense of security.

Assessing the overall security status must be the premise of an abstract threat. There is the possibility of random shots, aiming at diverting public attention from the recent failures of ISIS (loss leaders and controlled territories, limiting financial funds, vulnerability by failure of followers, etc.).

We meet sometimes politically motivated crime - ex. The Kurdish Workers Party (PKK). In the main, criminal or terrorist acts of some individual authors acting irrationally, should be considered as a possible separate politically motivated crime.

A pattern that emerges from the analysis of recent terrorist acts, DAESH uses young Muslims, born and raised in the West, coming from closed in Muslim slums, faced with poverty, crime and radicalization. They are marginalized and become permeable to rhetoric of terrorist organizations, which confirms their status of victims and legitimizes them to take action against oppressors (proof that current policies of cultural, social and economic integration failed). With a criminal past, often in prison, typically for acts of petty crime, they are specialized in the manufacturing of improvised explosive devices and is favored consumer shift from crime to terrorism.

Hidden conduct of jihadists supporters

The religious conflict from the Middle East was exported gradually to North Africa, then in the very heart of Europe through maturation and activation of new generations of young Islamists. They represent the offspring born Arabic diaspora across Europe, but they are indoctrinated with extremist values by influential agents from their origin countries. Without a special attention and clear measures of intervention from the European states, the embryo of the same phenomenon will occur over one or two generations to the current wave of migration, estimated to steady 1 million people annually.

The most obvious manifestations include violent statements, messages anti-Sunni, anti-Shiit and anti US and Israel, the radical propaganda, the supply of radicalization processes. Following integrated campaigns for public awareness on measures elementary and involvement of sight entities specializing in anti-terrorism community members sympathetic to radical Islam have implemented a set of rules for self protection. These implicate strict selection of entourage, both in social and in the virtual environment (removing people that can stay in touch with authorities, giving up accounts previously used for social networks, using applications that delete instant messages outgoing, replacement of traditional chat inviting the virtual camera within applications, games, forums etc.), limit and conspiracy phone calls (through the use of codes or innuendo, avoiding keywords), meetings in restricted

environments, controlled, with extreme precautions (regular anti-interception monitoring, sanctioning mobile phones outside the room, with the battery removed). As tools used to spread radical beliefs and popularizing measures to conspiracy and concealment of actions in training, given that the authorities are on alert and control the traditional channels they designed and widespread in the virtual cultural adaptation guides (The HOW TO SURVIVE IN THE WEST, DAESH - mujahid guide, with 71 pages in English, launched in March 2015 – ethics to hide extremist identity).

The maritime terrorism is a particular and rarer form of the international terrorism in comparison to the land and air attacks. This fact is explained by the high degree of intelligence needed to perform such actions which require careful planning, training, execution and capitalization.

Compared with a vest or explosive belt, a car bomb or a tele-detonated parcel, to attack a ship needs a huge logistics to be prepared. An assault watercraft, divers or submarines, an appreciable reserve of fuel, expert knowledge of structural ships characteristics, the additional facilities, the citadels of resistance arranged crew, war weapons and explosive material enough to pierce metal edges or protrusions. In addition, it requires a similar skill personnel boarded the ship to lead and to ignore or rendering harmless electronic safety devices to maneuver and get in the communication network without arousing suspicion. Additional difficult obstacles should not be neglected: the SSO (security officer on board), the CSO (officer in charge of security at the company level), continuous monitoring through specialized systems (eg. full live marine traffic map), satellite surveillance, private companies protection (that accompany cargo ships transiting dangerous areas for a reasonable fee) and various inter-institutional or regional initiatives to fight against crime. Terrorists don’t want many victims because they lose the public sympathy, but many people to watch. Triggering an attack by sea does not correspond to the sought profile. Unless terrorist suicide, when survival is not a factor, dropping to sea after an act of terrorism is very difficult.

Given the relative difficulty of undertaking a terrorist action on vessels, platforms or port facilities, we are in the presence of a strong link between terrorist organizations, That have access to adequate land and maritime infrastructure. It is a perverse effect of globalization in all its forms (biological, armed, chemical, nuclear, marine), being already an imperative of fighting and attitude of all states against forces promoting terrorism as a means of dividing the international community and slimming stability world in general. The act itself is perceived as illegal, illogical, immoral and often useless. Terrorism itself solved fewer problems than created.

Between the total threats and terrorist actions, those referring to "ships, fixed platforms at sea or in harbour or against any staff or their passengers, the facilities or coastal establishments, including tourists, resorts, port areas and port cities" are just a few percent, states are spending huge sums to protect the maritime transport infrastructure. Added to this is an important concern for international legislation harmonization at IMO and UN level. On the one hand, the life of crews and people who may be involved in terrorist activities cannot be quantified in money, on the other hand, it is destructive activity itself, which can be targeted to undermining the economy of a state (in terms where three quarters of world trade is carried through the 100,000 commercial vessels, operated by 1 million employees in this industry, connecting about 4,000 permanent civil ports currently active).

After a period of ship hijackings and hostage-taking, since 1960 was reached a level of important destruction and kidnappings, but concerted activities of states and authorities have made the number of successful attacks and violent actions to be relatively low since 2000. It talks more about robbery and maritime piracy in order to gain economic benefits and financial profits than about terrorist actions, politically motivated by the authors to determine their violent opponents of meeting the requirements and seek ideological sympathy, often ending in death.

Piracy is one of the financial sources of terrorism, is a provider of maritime terrorism or even a generator thereof. Sealing is Somalia, where pirates have people trained and provided naval wing of the Islamic terrorist organization al-Shabaab and helped this organization to smuggle weapons. Moreover, it seems that this terrorist organization would have liked through Somali pirates to sink a ship to block the Suez Canal.

Between the terrorist organizations worldwide recognized, with capacities to act destructively on ships and maritime infrastructure, the best known are:

• Al Qaeda;
• Abu Kidel Organization;
• Abu Sayyaf Group (which aimed to establish an Islamic state in the southern Philippines, and reports point maintains links with that Jemaah Islamiyah and Al Qaeda);
• Basque Brotherhood;
• Hamas;
• Hezbollah;
• Jemaah Islamiyah;
• Laskan e Tayyba;
• Eelam - the Tamil Liberation Tigers (who was reported to have the most sophisticated maritime capabilities among terrorist organizations around the world);
• GAM (Gerakan Aceh Mederka) group aimed of the Aceh recognition as independent Islamic state of Indonesia;
• OEP - Abu Abbas Brotherhood.

They act in the Arabian Peninsula, the Philippines, Indo-China, the Persian Gulf, the Strait of Malan, Suez, Africa, and Western Europe. Their main means of expression are:

• Suicide attack on a ship;
• Sinking ships;

• Capturing ships and uses them as a destroyer against other ships or port facilities;
• Attacking ships from the air;
• Attacking kamikaze submarine torpedoes or explosives;
• In Bab el Mandeb Strait, where 30% of maritime traffic passing year, capturing ships is the purpose of robbery or redemption of captives and plundering of transported goods.

In 2004, the Australian Foreign Minister Alexander Downer warned at a regional ministerial meeting on counter-terrorism in Bali that Australia and Indonesia, which hosted the meeting, intended to establish an anti-terrorist center in Jakarta. More than 200 people, including 88 Australians were killed in bomb explosions in Bali in October 2002. The explosions were linked by the Islamic organization, Jemaah Islamiyah, based in Indonesia, which allegedly has links with Al Qaeda. The government of Singapore said that American ships from Changi naval base have been the real target of attacks. According to the International Maritime Bureau, in 2003 there were 121 attacks in Indonesian waters.

According to the Report on the International Maritime Bureau 's piracy of the International Chamber of Commerce, in 2007-2008, worldwide there were a total of 293 incidents with 49 vessels hijacked, 889 crew members taken hostage, 11 killed and 21 missing, probably dead. Alarming is the rise of piracy and armed robbery attacks to the Gulf of Aden and the east coast of Somalia: 111 attacks with 42 ships hijacked. By the end of 2008, the Somali pirates were suspected for seizure of 13 vessels for ransom and 242 crew members hostage. Directly or indirectly as a result of the attacks, four crew members died, two were injured and 14 others are reported missing.

The Legal Codes in maritime terrorism

Currently, when in ports and on ships are concentrated millions of containers, goods and valuables, a single isolated terrorist group can produce enormous damage, with particular repercussions in the political, financial, economic and ecological crisis.

The huge dimensions of the potential disaster justifies and require all measures for prevention of terrorist events, especially maritime terrorism that could skid to mega-terrorism (use of means of mass destruction). Apart from the economic effects, such actions have a significant emotional impact that can be translated by giving up different tourist and economic destinations, avoiding routes, discouraging investments, closure of certain assets and economic activity and inception of nervousness, anger, distrust, also leading to great losses.

The Romanian legislation (Law no. 535 of November 2004 on preventing and combating terrorism) states that "terrorism is the set of actions and / or threats that present a public danger and affect national security, with the following characteristics: they are committed with premeditation by terrorist entities motivated by extremist beliefs and attitudes, hostile to other entities against which the modalities violent and / or destructive; aimed at specific, political objectives; targeting human and / or material factors within public authorities and institutions, the civilian population or any other segment belonging to them; producing states with a strong psychological impact on the population, meant to draw attention to the aims pursued ".

According to Alex Schmidt, "terrorism is a method that inspires anxiety, consisting of repeated violent actions, enforced by individuals, groups or states, acting masked, clandestine or semi-clandestine for political or criminal resons and, in opposition with assassination, the main target of violence, human victims or material damages are not the main pursued aim. The immediate human victims resulting from violence are chosen generally randomly (targets of opportunity) or selectively (representative or symbolic targets) and is only carrying a message. The communication process through violence or threat of violence, of terrorists and authorities, through the victims, is to manipulate the real target, which is public; making it a target of terror, a target of demands, or a target of attracting attention, depending on the purpose who can be intimidation, pressure to meet specific applications or a simple propaganda ".

It is obvious that maritime terrorism is at the beginning, but its development trends can become fast approaching the methods and diversified practice that, until recently, were considered unapproachable outside an ultra-professionalized framework. A diver from Kuala Lumpur reported that a number of Malays ethnic have expressed a desire to learn the secrets of the sinking, but although they were interested in the details of the profession, they have not shown any interest of decompression procedure, that is characteristic output to surface. It is known that terrorists are interested to learn diving to depths to attack ships through suicide bombings. Similarly, in 2000, in the Philippines, Abu Sayyaf Muslim terrorist group (the sword-bearer in Arabic) kidnapped a maintenance engineer in Sanah resort. The terrorists knew that the engineer was diving instructor and he wanted to dive instruction.

2. CONCLUSIONS

Due to more efficient security measures both on board of the ships and in port facilities, improving security measures concerning screening passengers and baggage and implement rigorous procedures for documentation crews and port staff, in compliance with the Convention on the Facilitation Trafficking maritime International (FAL), terrorist groups may be tempted to organize actions on mandatory places to pass for ships, such as straits, ports entrance etc.

Currently there is no exclusive maritime terrorist organization. But there is no guarantee that future classic terrorist organizations, with the ability to commit terrorist acts on land, will not prepare blows inland, air or ocean.

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INTERNATIONAL RELATIONS DEVELOPMENT STRATEGIES FROM THE PERSPECTIVE OF MARITIME FREIGHT TRANSPORT DEVELOPMENT

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ABSTRACT

Maritime transport is a catalyst for economic development, being an inexpensive means of transport, which can be profitable even for ordinary goods transport, due to relatively low prices, compared to other forms of transport. The economic development of society, and the development of transport, including maritime transport, took place simultaneously; there is a close interdependence between international economic relation development and the naval transport development: on the one hand, increasing business exchange among states triggers an increasing demand for transport and finally leads to increasing investments for transport development and, on the other hand, transport development (by improving transport means, ports, airports, railways, pipelines, creating new transport routes facilitating commodity exchange and reducing transport costs) has an active influence on international commodity exchange development

Keywords: *sustainable development, strategy, economic growth, international relations.*

1. INTRODUCTION

Maritime transport, part of the international transport is a highly complex and extended economic activity, whose development is closely related to the world market development, to the economic cycles, with a significant contribution to the evolution of the global economy. Maritime transport is the cheapest way between production and market, providing large quantities of goods in a quite short period of time, in safe conditions which are strictly regulated worldwide.

Maritime transport, economic activity developed by states or private companies, is included, by its complexity and its particularly great value, in the field of the international relations. This led to the necessity of international cooperation which must ensure, through the most celebrated institutions around the world, clear, firm and precise rules on: safety of life at sea, safety of ship and cargo, safety of navigation, in general, ways of avoiding accidents at sea, or/and in port, organization of maritime rescue and assistance operations, rules of transport adapted to the different types of cargo, protection of ship owners and cargo, etc. The purpose of this type of international cooperation is equity and mutual benefit. The new economic cycle of growth, though, still poorly represented at the global level, will require a new approach to the development of international maritime transport. In 2013 the economic growth was of 2,3%, in 2011 it was 2,8%; the estimated growth of 2.7% is expected in 2014, while the world trade growth was 2.2% in 2013, compared to 2.3% in 2012. The seaborne trade in 2013 had a positive development, with an increase of 3.8%, with a total of 9.6 billion tones of shipped goods[1] (table 1 and figure 1).

Table 1. Loaded/unloaded goods in 2013 (%)
Source: UNCTAD Review of Maritime Review, 2014, p.8

	Goods loaded			Good unloaded		
	Crude	Petroleum products &gas	Dry cargo	Crude	Petroleum products &gas	Dry cargo
100 %	18,4	11,4	70,2	19,9	11,5	68,6

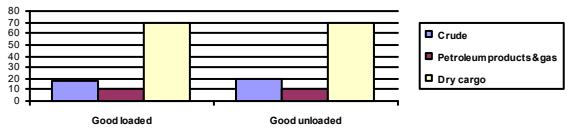

Figure 1 Loaded/unloaded goods in 2013 (%)
Source: UNCTAD Review of Maritime Review, 2014, p.8

All goods transported by sea, by groups of goods and the percentage in 2014, are presented in Table 2, Figure 2.

Table 2. Total transported goods by sea, according to the type of cargo in 2014 (billion tones/mile)
Source: UNCTAD Review of Maritime Review, 2014, p.12

Gas	Oil	Container	Other (minor bulk&others)	Five main dry bulk (iron ore, coal, grain, bauxite&alumina, phosphate rock)[2]
1330	12117	8466	14487	16018

[1] UNCTAD *Review of Maritime Transport*, United Nations, New York and Geneva, 2014

[2] Non-containerized bulk cargo is : iron ore, coal, grain, bauxite and alumina, phosphate, and goods shipped as individual units: equipment, machinery, timber, etc., packaged or unpackaged

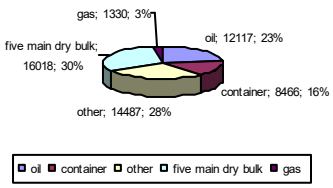

Figure 2 Goods transported by sea in 2014 (%)
Source: UNCTAD Review of Maritime Review, 2014, p.12

2. MATERIALS AND METHODS

A dictionary definition of the term international relations covers all political, economic, cultural, social, legal, diplomatic, etc. relations between states. All these relationships are regulated by legal juridical documents, principles and norms of international law[3]. For this article we are interested in the biunique links between international economic relations (and also the related the legal and political ones) and the international maritime transportation

A definition of international economic relations is the one in which they are defined as the set of economic relations covering: trade, services, relationships of the production and scientific research, the credit and financial relations, and any other operation by which the world's turnover is made.[4]

3. RESULTS

Today, the international economic relations must be understood in all their complexity because they are the most important connections between countries, peoples, and companies, having a value volume in the year 2012 of about: 18323 billion USD for goods, 4345 USD for services, of which: 855 billion USD for transport, 1105 billion USD for tourism, and 2350 billion USD, for other services[5]. The international economic relationships are in accordance with the global economy. Development strategies of international economic relations involve establishing, at macroeconomic level, short and long term objectives, based on knowledge of the sphere of influence, resources, and distinguishing the main characteristic, and the synergistic effect. The development of the world economy is directly related to the evolution of the FDI (*Foreign Direct Investment*). After falling in 2012, the FDI began to grow by 9% in 2013 to a 1,450 billion USD value, and an estimate of steady growth until 2016 (1800 billion USD)[6].

[3] http://dexonline.ro/definitie/rela%C8%9Bie
[4] http://www.manager.ro/dictionar/relatii-economice-internationale/2263.html
[5] http://www.iem.ro/ro/publicatii/piaa-international/economia-tarilor-lumii
[6] UNCTAD Word Investment Report 2014, United Nations, New York, Geneva, 2014

The FDI flow situation by regions, in the period 2011-2013 was as shown in Table 3 and Figures 3, 4, and the percentages in Figure 5, 6:

	FDI inflows				FDI outflows		
	2011	**2012**			**2011**	**2012**	**2013**
World	1700	1330	1452		1712	1347	1411
Developed[7] economies	880	517	566		1216	853	857
Developing[8] economies	725	729	778		423	440	454
Transition[9] economies	95	84	108		73	54	99
		Percentage share in world FDI flows					
Developed economies	51,8	38,8	39,0		71,0	63,3	60,8
Developing economies	42,6	54,8	53,6		24,7	32,7	32,2
Transition economies	5,6	6,3	7,4		4,3	4,0	7,0
Total	100	100	100		100	100	100

Table 3World Foreign Direct Investment 2011-2013
Source: UNCTAD World Investment Report 2014, p.36

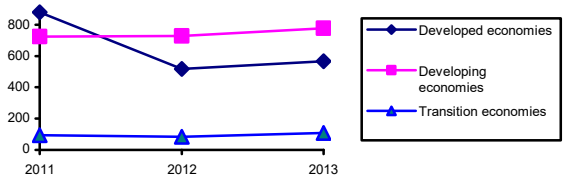

Figure 3 FDI inflows in 2011-2013

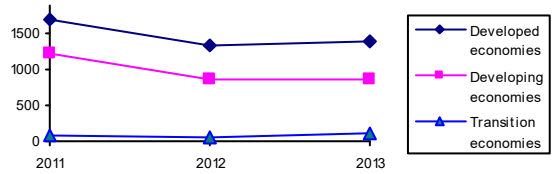

Figure 4 FDI outflows in 2011-2014

[7] the member countries of the OECD (other than Chile, Mexico, the Republic of Korea and Turkey), plus the new European Union member countries which are not OECD members (Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta and Romania), plus Andorra, Bermuda, Liechtenstein, Monaco and San Marino, UNCTAD Word Investment Report 2014, United Nations, New York, Geneva, 2014
[8] in general all economies not specified above. For statistical purposes, the data for China do not include those for Hong Kong Special Administrative Region (Hong Kong SAR), Macao Special Administrative Region (Macao SAR) and Taiwan Province of China, UNCTAD Word Investment Report 2014, United Nations, New York, Geneva, 2014
[9] South-East Europe, the Commonwealth of Independent States and Georgia, UNCTAD Word Investment Report 2014, United Nations, New York, Geneva, 2014

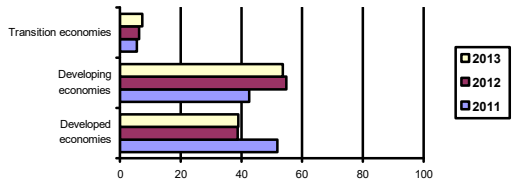

Figure 5 Percentage share in world FDI inflows in 2011-2013

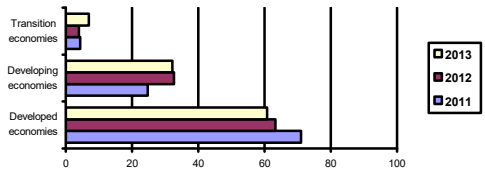

Figure 6 Percentage share in world FDI outflows in 2011-2013

Today, the development of human society, at a global level, cannot be done without taking into account its sustainability on medium and long term. Due to the rapid economic, social and environmental changes, at international level, more and more countries can no longer develop alone. Therefore, they were organized into political, economic and military unions, organizations, etc., with divergent interests, but also convergent ones, to cope with the challenges of the next period, characterized by a unprecedented demographic pressure on resources. The international relations must take into account these new realities, must rearrange, and, apart from the theory of globalization, must also find other development strategies. At the United Nations level there sustainable development goals (Sustainable Development Goals - SDGs) for the period 2015-2030, were issued and pursued, so as to ensure poverty reduction, food security, public health and education, climate change mitigation, not leaving apart the main objectives related to economic, social and environment development[10]. All these objectives can be achieved only with government and private investment. Only for basic investments in infrastructure (roads, railways, ports, energy, water and sanitation), food security, combating the effects of climate change, health and education the value is estimated at 5000-7000 billion annually[11]. The meet these objectives the developing countries need an additional investment of 2,500 billion annually[12]. Unfortunately, especially in poor countries, the private sector contribution to the sustainable development objectives is low. To this end, UNCTAD has elaborated a private investment plan for achieving the *Objectives of sustainable development* which consists in the following strategic lines: a new phase of investment promotion and facilities in sustainable development, stimulating investment in sustainable development, compact investment at regional and cross-border levels, new forms of public-private partnership, activation of innovative financing mechanisms, and reorientation of financial markets towards fund-raising politics; other lines of this plan are changing the mentality referring to such types of investment, and also, developing expertise in this area[13].

At present, the maritime transport is considered a catalyst of the economic development, since it is known that it is cheap and cost-effective in relation to land, rail, air, transport. The economic development of human society has also implied the development of transport, including the maritime one, which, by definition, has an international and even global character (Earth is covered by water for more than 70% of its area). Between international economic relations and maritime transport there is a close interdependence: increasing economic exchanges enlarges transport requirements, leading to higher investment for its development, and the development of transport (by improving the means of transport, ports, airports, railways, pipelines, the emergence of new transport routes, which facilitate the exchange of goods and reducing transport costs) has a direct and active influence on the development of international economic, and not only, relationships. The analysis of maritime transport for the period 2013-2014 shows that, with the increasing global economy and the value of direct investment in the economy (above), the need was felt to increase the tonnage of the world fleet (Table 3), so as to be able to support this growth.

Table 3 World fleet by principal vessel types, 2013–2014 (thousands of dwt, percentage share)
Source: UNCTAD Review of Maritime Transport 2014, p.29

Year/thousands of dwt	2013	2014	Percentage change 2014/2013
Oil tankers	472 890	482017	1,9%
Bulk carriers	686635	726319	5,8%
General cargo ships	77589	77552	0,0%
Container ships	206547	216345	4,7%
Gas carriers	44346	46427	4,7%
Chemical tankers	41359	42009	1,6%
Offshore	68413	71924	5,1%
Ferries an d passenger ships	5353	5601	4,6%
Other	22621	234343	3,6%
World total	1625750	1691628	4,1%

A current classification of the first commercial fleet shows, on 1 January 2014 shows that[14]: Greece, Japan, China, Germany, South Korea, Singapore, USA, UK, Taiwan, Norway, have a big a big merchant fleet (even if the fleets of the top 10 include ships under flags of convenience); this is the prerogative of developed countries with developed naval traditions.

To further understand the link between economic power and containerized transport, the peak of maritime transport, we present the top ten container ships companies (Table 4).

[10] UNCTAD Word Investment Report 2014, United Nations, New York, Geneva, 2014
[11] Ibidem
[12] Ibidem
[13] Ibidem
[14] UNCTAD Review of Maritime Transport 2014

Table 4 Top 10 container companies 2014
Source: UNCTAD Review of Maritime Transport 2014, p.40

Company	Country	Ships	TEU
MSC Mediterrannean Shipping Company	Switzerland	461	2609181
Maersk Line	Denmark	456	2505935
CMA CGM SA	France/SUA	348	1508007
Evergreen Line	China	229	1102245
COSCO Container Lines Limited	China	163	879696
Hapag-Lloyd Aktiengesellschaft	Germany	159	762613
China Shipping Container Lines Company Limited	China	134	750644
Hanjin Shipping Company Limited	China	115	671210
APL Limited	SUA	121	629479
United Arab Shipping Company (SAG)	Bahrain, Iraq, Kuwait, Qatar Saudi Arabia and U.A.E	73	610294

From this statistic we can easily see the direct relation between economic power and position in the top: the largest company is in Europe, four companies are Chinese, two are American companies, and another one is Arabic.

Another parameter analyzed in the evolution of shipping is the shipbuilding activity. The percentage of the increase recorded, although still rising, for the year 2013 is lower than in the previous 10 years, a trend that was maintained in 2014. Apparently, the growth cycle of shipbuilding started to grow again, but not at the level of the year 2012, when shipbuilding reached the peak.

Freight global market analysis shows that after the 2009-2012 economic recession, the year 2013 was still problematic, with low levels for dry and liquid bulk cargo freights, and also for the containerized cargo, due to the still weak tendency of economic development, decreased transport demands, combined with a greater than necessary transport capacity.

4. CONCLUSIONS

The two years, 2013 and 2014, failed to ensure vigorous exit from the global economic crisis. However, this period under review, compared with previous years shows signs of a resuming the global economic development cycle. The international relations follows this trend, too. World organizations such as UN, UNCTAD proposed and discussed long-term sustainable growth plans, supported by an international direct investment, (governmental and private), in a new, attractive and effective vision. International maritime transport, as the most important transport underlying global economic relations have experienced the same trend of resetting, of slight increase on all its levels (management, new construction, freight market, etc.). This trend looks like it will e kept, at least for 2015[15]. Since the global economy and the flow of investment in the economy will keep their upward trend, there are economic and political basis to provide a future development to the international maritime transport. Today, maritime transport is one truly global market, worth thousands of billions, through its main components, goods, vessels and freight. It is very sensitive to any oscillation of the global economy, but has a certain inertia due to the size, complexity and number of actors involved. Shipping, through its strength, capacity, investment and number of employees have the ability to act positively or negatively on the development of national, regional and even global economies.

Given the upward trend of the world economy, we consider that the development of world seaborne trade will increase in the coming years (in percent) higher than the world trade, by more than 3 percent annually, or more.

It is likely that the volume of goods transported by sea to grow more than 10 billion tones of shipped goods / year.

Also, in the next years the shipbuilding activity will increase, more than 3-4% annually, in particular the construction of new container ships, very large bulk carriers, very large oil tankers and passengers ships.

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[9]*** UNCTAD Review of Maritime Transport 2012
[10]*** UNCTAD Review of Maritime Transport 2013
[11]*** UNCTAD Review of Maritime Transport 2014
[12]***UNCTAD World Investment Report 2010
[13]***UNCTAD World Investment Report 2011
[14]***UNCTAD World Investment Report 2012
[15]***UNCTAD World Investment Report 2013
[16]***UNCTAD World Investment Report 2014 Investing in the SDGs: An action plan

[15] UNCTAD 2015 partial reports

DOBROGEA GEOGRAPHIC AREA INFLUENCE ON THE OCCURENCE AND DEVELOPMENT OF WATER TRANSPORT FOR ROMANIAN PEOPLE

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ABSTRACT

Dobrogea and its seaside represents the natural physical-geographical approach framework to the Black Sea and the World Ocean for the Romanian people. The development of the Romanian naval industry is closely connected with this area. The connection between the geographical Dobrogea framework and the maritime policy of the Romanian state influenced the occurrence and the development of the water transport for the Romanian people.

Keywords: *Dobrogea, geographic influence, water transport.*

1. INTRODUCTION

Danubian-Pontic geographical space represented since antiquity an propitious environment to the occurence and development of seamanship for Romanian and the construction and development of statehood with its ups and downs, have directly influenced the rise and fall of Romanian sea power to the Black Sea.

The history of Dobrogea and the Romanian Danube region recorded alternating periods of flowering and decay starting from the Thracian period. Current historical and archaeological research shows that on the western shore of the Black Sea there was a Thracian maritime tradition long before the Greek colonization. Greek colonization of Pontus Euxin coasts began in the seventh century BC when the following ports cities were based on the western shore: Callatis, Tomis, Histria, Aegissus, Argamum, etc. settlements that have proven their value and vitality through time by today Romanian harbours, which shows that since that time the geographical conditions were favorable for this [3,4 5].

2. MATERIALS AND METHODS

This article is based on study of the most popular Romanian bibliography souses on the Romanians history of navigations.

The methods used for this brief historical research are diverse: observation, comparison, analysis and synthesis, criticism and interpretation.

They were depending on sources users fully investigated and complexity of responses to be formulated in relation to various issues addressed.

Heuristics, or the art of discovering (identify) the historical sources and formulate problems in relation to historical research is an essential first step investigations. Historical issues involving more precise contours. They are not based on speculation or abstractions. The same happens in the case of historical sources, which are not selected by chance, but in direct line with the issue under discussion. Criticism is actually dialogue between history and historical sources. History envisages the authenticity of the source.

3. RESULTS

Navigation and trade on the Danube kept continuity through the ancestors of the Romanians. They used since the beginning both the *monoxila* and the boat, then evolved boats for sailing, fishing, transport of goods by inland rivers and the Danube. These boats were used for military purposes too. The Dacian people were sailing on the Danube for commerce and fishing, but also at sea to attack the Greek colonies of Pontus Euxin. Dacian kings used numerous large craft for their military expeditions to the south of the Danube [2]

In the first century BC the Roman Empire reaches the Danube, conquering Greek port-cities and Dobrogea region is attached to the Roman province Moesia; during the Dacian wars and water conflicts with Dacians and the Romans arise, using their ships to carry and the landing troops. Roman conquest of Dacia provided the possibility of transforming the Danube and Black Sea into principal trade routes for the empire, defended by a strong navy that had strong forts and ports.

In Roman times the development of navigation and trade on the Danube imposed the river fleet development (Classis Flavia Moesia), sea fleet development (Classis Flavia Pontica), appearance of maritime prefecture in Tomis (Orae Maritime Prefecture), development of shipowners associations, called colleges (Colegium Nautarium from Dierna - Orşova), the occurrence of marine education (Nauti Universitae Danubi from Axiopolis - Cernavoda).

Among the ancient port located on the western coast of Pontus, Tomis who became a free port around 260 BC, remained and remains the leader and emblem of seafarers on these lands, from antiquity to present days.

The period of III - VI AD centuries, period of the migration, brought important politic, social and economic changes in these regions. As the Roman reign began declining, navigation on the Danube and the Black Sea followed the same destiny. In 248 AD Histria was destroyed, and in 267 AD the Danube and Pontus ports were destroyed too. After the withdrawal of Emperor Aurelian from Dacia, the Danube crossings were controlled by the Romans, in order to have control over the Danube north territories. Byzantine Emperor

Constantine the Great annexed territories comprising of Muntenia, Oltenia and Dobrogea, restored Tomis fortress and as a result the river and the sea navigation meet a new flowering. Invasions of Goths (364 AD), the Huns (375 AD), the settlement of Slav at north and Bulgarians at south of the Danube (678-680 AD) had a negative effect on navigation and trade on the Danube. The Byzantine fleet had the task of defending the borders of the empire and the river navigation. It is worth noting that the development of early Romanian state imposes the development of navigation and trade on the Romanian inland water (there is evidence of salt transport on inland rivers Mures and Olt in XI - XIII centuries). [3]

During the formation and consolidation of Romanian Countries (XIV – XV centuries) navigation and water trade was developing, boats and ships were built, thus the Danube and some maritime ports were experiencing a new period of flowering. The Romanian king "Mircea cel Bătrân" reached the "great sea" and was concerned with the development of the river and maritime ports Tomis and Callatis while the Moldavian „*panzare*" (sailing vessels with a length of approx. 17 m, width of 4 m, tonnage approx. 60 tons, probably built right in Chilia and Cetatea Alba) are known in the whole Black Sea basin, and even in the Mediterranean (Figure 1).

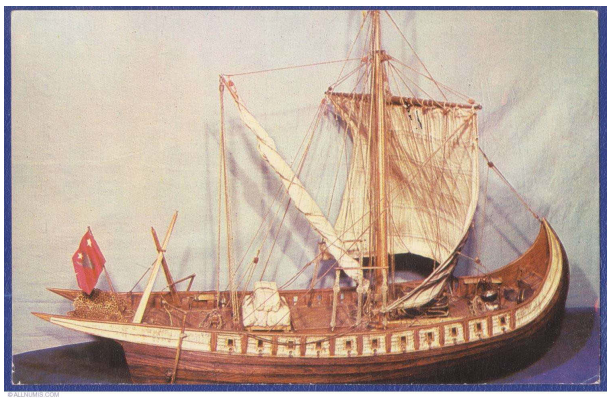

Figure 1 Moldavian Panzar
Source:http://www.allnumis.ro/catalog-carti-postale/romania/muzeul-marinei-romane-constanta/constanta-muzeul-marinei-romane-panzar-moldovenesc-nava-maritima-sec-xv-xvii-model-3271

The development of Merchant marine was a basic element of the Moldovian state's of king "Stefan cel Mare" [2,3,10] with Licostromo - Chilia and Moncastro – Cetatea Alba cities-ports on the Black Sea seaside (during the years 1465-1484). Through these ports and also through Braila and Galati ports there was an intense trade with Poland, the countries of South - East Europe and the Middle East (a Venetian report shows that in 1462 a Valach ship was detained to Constantinople and then released - probably for nonpayment taxes or debts). [5,8,9].

The fall of Moldovian Port cities to Turks in 1484, is the moment when Moldavia ceases to be a maritime state and led to the establishment of Ottoman rule over the Black Sea which will be full a "Turkish lake" for more than 200 years [3].

The Romanian reign of Romanian kings „Vlad Tepes" and „Mihai Viteazul" bring again to light the navigation, ships and ports role in the successful battles against Ottoman Empire. By occupying the Danube main passes and customs, Romanians navigation and trade fall under the control of the Ottoman Empire.

Romanian states prosperity of this glorious period allowed the development of Romanian Navy and Romanian Merchant Marine as basic elements of Romania's economic and military political power in time, a phenomenon that continued and enriched the naval tradition for centuries.

The Danube and the seashore protection was based on the cooperation between warships, permanent garrisons in the riverine cities, coastal defense forces on land and river, and maritime communication routes with hitting enemy ports. This strategy, current today, by which the Romanian countries ensured their freedom, independence and free trade shows understanding that a maritime and river country can not live without a free and prosperous naval power necessary to achieve this goal.

The period of Ottoman reign represented difficult period for Romanian navigation that was subordinated to the interests of the High Gate. However, in these conditions, this activity has not ceased, Romanians continued their sea trade, built boats and ships, and constituted crews for many Romanian and Turkish ships.

The Danube ports, Galati and Braila, and Black Sea ports, Constanta and Mangalia, were developed for the Turkish trade interests. Through these ports an intense transit of goods manufactured from Poland, Austria, Hungary, Transylvania and grain and other products of Romanian countries to Constantinople were conducted. Romanians attended with their boats and ships on the Danube and sea their goods transport, on Sultan order.

Changing of the international ratio of forces, the decline of the Ottoman Empire and the Habsburg Empire and Tsarist empire desire to dominate the Danube and the Black Sea resulted in attracting Romanian States under Turkish suzerainty in increasingly harsh conflict between these three empires.

The wars and battles carried on Romanian territories and the Danube and sea battles had a negative impact on political and economic situation of the Romanian states, on navigation and trade, so after the Russo-Turkish War of 1806-1812 Russia occupies Bassarabia, extends its domination over Danube arms Chilia and Sulina, becomes a Danube riparian country, yet another step towards achieving its dream to control the Black Sea, the Bosporus and Dardanelles. In 1815 by the final act of the Congress of Vienna is dedicated to the freedom of inland navigation except on the Danube waterway, as neither Russia nor Austria did not want the presence of other European powers in the region.

Sulina freight traffic increases, which requires maintenance of the fairway and a lighthouse is built (1818).

The involvement of the Romanian states in the regional policy was modest, in 1856 after the Paris Peace Conference the "European Danube Commission" was founded which included Austria, France, England, Prussia, Russia, Sardinia and Turkey, with the task of proposing and performing necessary work for sailing from Isaccea to the sea, to the seaside and "Riverin Commission" made up of Austria, Bavaria, Turkey, and Württemberg and commissioners from Serbia, Wallachia and Moldavia for the rest of the river, from Isaccea to Orşova; this Commission will become the "International Commission of Danube" changed to "Danube Commission" after World War I, based in Budapest.

Until the Romanian Independence War the foundations of modern Romanian Navy are set so that during the Wallachian Prince Alexandru Moruzzi (1793-1796) a "Danube Commercial reign Fleet" was organized under Romanian Country flag led by Ienăchiță Văcărescu and was organized in princely ships, counties and villages ships such as "*bolozane*", "*saici*" (figure 2) and "*caice*", "*ceamuri*" and "*acicuri*"; beside these there were individual vessels that brought significant revenues to the royal treasure through transport.

Figure 2 Ofidia ("□aica"-barcă de război) "*Cetatea Albă*" purtând stema medievală a Moldovei şi capul de bour la prova
Source:https://ro.wikipedia.org/wiki/Muzeul_Marinei#/media/File:Ofidia_Cetatea_Alba.jpg: public domain

In 1834 in Giurgiu "Maritsa" is built, the first vessel under Romanian Country flag and in the same year "Rucsandra", "Sf. Dimitrie", etc. received the right of navigation on the Danube and sea under Moldovian flag.
In 1837 arrives at Braila, coming from Constantinople, the first foreign steam ship. Between 1833 - 1839 more vessels enter service under the Romanian flag: galleys "Elena", "Xenocrat", "Athens" barques "Elizabeth", "Zimnicea", "Danube", "Sf. Nicolae" and schooners "Dochia " and "Speranta".
In 1839 the merchant marine of the two Romanian principalities consisted of 20 vessels at which mast waving yellow and red with stars and royal eagle flag (Romanian Country) and blue with red squares at the four corners of the country shield supported by two dolphins and bison with a star between horns (Moldova). [2,7]

In 1850 Moldavia had 76 navy ships some of them with 300-400 tons tonnage, and even more; between 1859 –1861 the first steam ship, of Ceocan, appears, executing salt and wood transport on the Danube and Siret.

In the period up to national independence, Romanian navigation and commerce was conducted under the suzerain power control, Turkey; the development of Romanian economy has influenced in better the navigation and export through the Danube ports, so that from 6.7 million hectolitres of grain in 1867 there was 15,900,000 hectolitres of grain exported in 1876. [5]

In 1861 the "First navigation Regulation for the Merchant Marine of the United Principalities" appears that states the necessary documents of a vessel, leaves, crew role, ship inventory.

The reign of Alexandru Ioan Cuza was a propitious time for the Romanian state development, strengthening and upgrading its economic and military structures, broadening trade links with other countries, the development of navigation and trade, the development of military and trade fleets, to protect and promote the Danube and the sea Romanian interests. Merchant Marine develops, so that in 1860 in Constantinople are recorded 400 Romanian ships entries and, in 1863 there were 1711 vessels entries of a displacement of 293 984 tonnes in 14 Romanian Danube ports.

After gaining her state independence Romania has developed both social - political and economic terms which imposed sea and river transport development in support of Romanian trade.
The evolution of Romanian maritime transport is linked to the emergence of Romanian modern state, by political, economic and industrial evolution, starting with the last years of the nineteenth century.

The need for a national shipping company, for a Romanian Merchant Marine became apparent. Economist P.S. Aurelian states in 1887 that "we have a sea, and what is more we have the mighty Danube which wets Romania more than half of it's length, we have more and abundant waters within the country and yet we took all by a little bit, but we left the marine in desolation. It could be thought that we don't realize the great usefulness for Romania depicting both politically and economically possession of a national marine".
In 1888 a law was passed to establish a Merchant Marine but credit was not granted.

In 1890 the "Romanian River Navigation Service" - (NFR) is set up. In 1895 the "Romanian Maritime Service" (SMR) is set up, more ships are bought, and in 1896 was organized a scheduled passenger and goods (parcel) between Braila, Constanta and Constantinople with cargoships " Principesa Maria" and "Regele Carol", (figure 3) and a Western maritime line with cargoships "Dobrogea", "Iaşi", "Turnu Severin" and "Constanta", was developing; three ships "Romania", "Dacia" and "Impăratul Traian" perform scheduled passenger to Egypt and Palestine. [4]

Under the command of Navy active or reserve officers, these ships have been quickly noticed for safety and punctuality and Romanian officers began to look for shipowners in England for long and distant voyages.

In 1907 the "Law for organizing Merchant Marine" is promulgated, law protecting Romanian development

interests in shipping matters and regulating the establishment of private Romanian shipping companies.

Figure 3 SMR *Regel Carol*
Source: https://ro.wikipedia.org/wiki/SMR_Regele_Carol_I#/media/File:SMR_Regele_Carol_I.jpg: Public Domain

Since 1914, private shipping companies begin to appear, cargo ships of 6-7000 tons, so that in 1930 there were 27 Romanian ships with a tonnage of 96,895 tons. In the interwar Romanian merchant maritime fleet development is influenced by the evolution of Romania's foreign trade relations and navigation concluded with 16 countries (Turkey, Poland, France, Great Britain, Italy, Norway, Portugal, Greece, Ireland, Netherlands, Sweden and others); although most of them had previous World War agreements they were renegotiated at international requirements in force. These arrangements in the field of maritime transport and trade have allowed the development of shipping companies while new shipping lines were established. Romanian Maritime Service was the primary factor for increasing Romanian transit of goods through the Romanian ports. [5,6]

Thus during this period there were several shipping lines that ensured the transit of goods to:

- East, through the port of Constanta, connection with Romanian railway and ports in the Middle East;
- East, ensured connection to Central Europe by port of Giurgiu (where cargo was transported by river vessels), railway, Constanta, and by sea with vessels SMR and sea vessels with East ports;
- Mediterranean, ensured Northern and Central Europe connection by river and by sea vessels with the Mediterranean ports; the goods were taken from Galati by SMR ships;
- Levant, ensuring connection with the Polish and Romanian railways by Romanian ships with Levant ports.

In the mentioned period Romanian Maritime Service participated in passenger traffic between central and northern Europe and Middle East ports, by the ports of Galati, Sulina and Constanta (travellers could buy coupons combined CFR (Romania Railways) - passengers ship).

The period of the Second World War led to a drop in commercial traffic in the Black Sea ports, maintaining close ties with the Middle East and the Mediterranean ports. Renouncing the western European ports connections, many ships were seized and taken over by authorities of other states during the war, so that Romanian Maritime Service had 16 merchant ships on the entry of Romania into war.

During Romania commitments under the World War II the merchant ships were used in transport missions, minor and safe in support of military sea combat operations executed by Romanian ships (noting is the fate of two passenger ships " Transilvania" and "Basarabia" which were held by the Romanian state by the end of the war with safety crews, with pay port charges, in Istanbul). [36]

Figure 4 Passenger ship *Transilvania* in Constanta Harbour
Source:http://tramclub.org/viewtopic.php?t=10490&start=50&sid=ccc4ff1bd3f0482d58a0f1dbdeb4bf15

Romanian crews of merchant ships participating in war missions have shown exemplary professional training and a special dedication for ship and marine.

The end of the war finds Romania with one merchant ship "Transilvania" others being lost in war or were requisitioned by the Soviet Union; at October 12, 1945 some of the requisitioned military ships are returned and the cargo ship "Transylvania", so that there was virtually no Romanian merchant fleet.

In the period 1945-1955 Romanian freight transport was provided by the company "Sovromtransport" under Soviet control, initially with four old cargo boats, which were added another 4 old, also with "Ardealul" and "Transilvania" and other small motor vessel built in Braila and Turnu-Severin shipyards.

Until the 50s transportation in Romania experienced a period dominated by a single transport system - rail, while the river, sea, air and pipeline transport represent 46% of transport volume and around 35% of the distance traveled to the total freight and passenger traffic below 5% and 4% of the way.

After this period we can speak of a rapid increase Romanian maritime fleet and the strong development of waterborne transport of goods.

In 1955, when „The Enterprise for Maritime and River Navigation-"NAVROM" was established commercial fleet activity goes under the Romanian State, and until 1960 there are 10 vessels with a total tonnage of about 35,000 dwt.

After 1960 Romanian Merchant fleet develops and the number, size and types of ships built in shipyards in

the country and abroad is increasing; the first ship built at Shipyard Galati was cargo "Galați", the first series of 4500 DWT freighters.

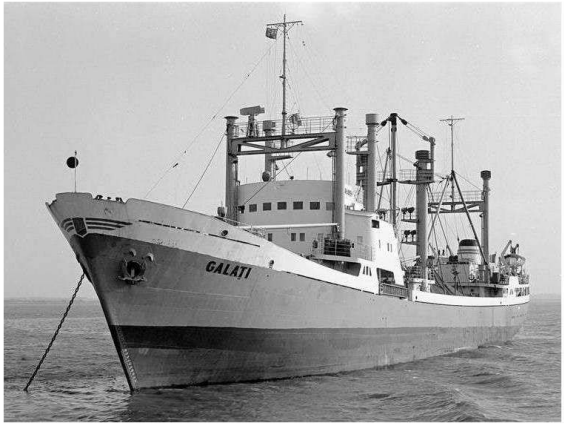

Figure 5 Cargo ship *Galati*
Source:http://www.magazin-nautic.ro/wp-content/uploads/2012/01/GALATI-primul-cargou-de-4.500-tdw.-construit-in-Romania-1959.jpg

In the 1960-1965 period NAVROM receives 27 vessels of all types with a total tonnage of 142,415 dwt; between 1966-1970 another 18 new ships were added, between bulk carriers and tankers, Romanian maritime fleet capacity increasing to 341,222 dwt.

Three services line were developed:
- Constanta - Levant, with cargo on the route Constanta - Lattakia - Limassol - Beirut - Alexandria - Constanta;
- Constanta - Western Europe, with cargo on the route Constanta - Hamburg - Rotterdam - Antwerp - London - Constanta;
- Constanta - Far East;

and links with ports in North and South America, Japan, India; in 1969 the Romanian ships entered in over 200 ports.

Between 1971-1975 the number of Romania vessels increased by another 45, of which 36 were built in Turnu-Severin, Braila, Constanta shipyards, general cargo and oil tankers with 55 ÷ 85,000 dwt displacements.

Romanian merchant fleet has provided 18% of the Romanian shipping in 1966-1970 and 27% in 1971-1975 with 123 ships and a total tonnage of 1,711,000 dwt.

Romanian merchant fleet continues its development according to the needs of the Romania economy, so that at the end of 1979, the merchant fleet would be composed of 153 vessels (103 cargoes, 42 bulk carriers, 8 tankers) with a volume of 20 million tonnes of freight transported with connections to 300 ports worldwide [11].

After 1980 large ships are built, 65,000 DWT bulk carriers, 150,000 DWT tankers (Figure 6), RO-RO ships (transport vehicles) and ferries, container ships.

Figure 6 Oil Tanker *Biruinta* 164.000 tdw

4. CONCLUSIONS

On 31 December 1989 the Romanian merchant fleet had 311 ships with a total of 6,185,101 dwt: 55% bulk carriers, 24% cargoes, 21% tankers.

Romania's Revolution of December 1989 brings changes of the entire Romanian society, changing the Romanian merchant fleet. NAVROM division into three shipping companies "Navrom", "Romline" and "Petromin" is decided and so began the Romanian shipping privatization.

Then, for 15 years Romanian Merchant fleet went through a very difficult period, left with external debts of $ 29 million in 1989, badly led, benefiting from an unfavorable business environment is virtually destroyed (the three state companies - bankruptcy and liquidation and private, early, survives the transition conditions of the Romanian economy to the market economy and the Romanian state policy incoherence and naval transport industry) [1].

Now, after official sources (Review of Maritime Transport, 2014), Romania registered owners have 94 vessels with a displacement of 1.044 million dwt., of which 55,000 dwt Romanian flagged and 989,000 dtw foreign-flagged (94.73%), which is 0.062% of the total world fleet. One of the few surviving Romanian ships is Albatros (Ex. Dej) (Figure 7)

Figure 7 Cargo ship *Albatros*

The construction and development of Romanian seaports experienced a similar history to Romanian shipping, knowing close and direct link between the port and the ship as the recipient and carrier of cargo.

Favourable geographical conditions ensured, as noted above, the appearance of the old ports on the Romanian Black Sea coast which have grown with the development of the State have declined with the weakening of state power. In the twentieth century, due to the economic development of Romania began the extension of Romanian ports beyond the limit for which they had favourable geographical conditions, so that the first negative effects of non-human harmony between them and constructions appear. Negative anthropogenic effects on the coastline and marine environment proved to be long term, and their removal is proving sluggish and expensive.

Romania presence to Black Sea and from there to the world's oceans is made by its coastline, through its ports and by commercial and military ships with Romanian flag. All this, along a seamanship conscience, naval industry, shipbuilding industry and specific infrastructure constitute the elements of Romania maritime power; any decrease of one of these elements lowers maritime power of Romania, any unfavourable Romanian economy is reflected in the weakening political power of the country (and vice versa), and hence the state's power projection on maritime domain, and from here negative developments of some elements of maritime power.

Whenever in history, the Romanian states were strong and were powerful a corresponding maritime power was projected, with beneficial influence on the social and economic life; when they were weak and their maritime power declined or was missing.

Landlocked is a given geographic blessed, but it can not by itself fill a duty to the state and society, firstly, to preserve it and then use all the advantages of it.

Given the known importance in the exploitation of marine resources in the near future, deep understanding of the role of national geographic framework, namely the area of Dobrogea and the Romanian seaside, without others cannot exist, politics, economics, human activity, etc. should result to the potential of the shipping industry and maritime transport, otherwise, not only economic losses will be incalculable.

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SUSTAINABLE PASSENGER TRANSPORT IN EUROPEAN UNION

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ABSTRACT

In the framework of sustainable development, every member states of European Union has to cope to a huge challenge, that of the economic growth of urban areas without prejudicing the quality of life and the environment protection. Because transport is the blood of the entire economy, the development of a sustainable transport would be the answer to this challenge. The present paper outlines the role of sustainable transport and especially, passenger transport in the context of a new urban mobility pattern. It emphasizes an overview of passenger transport in European Union and it presents solutions of making passenger transport sustainable, best practices related to this subject and measures for sustainable urban transport. I have realized this summary analysis of several aspects of sustainable passenger transport to focus on public awareness regarding a positive attitude for sustainable behavior in terms of economic, social and environmental issues involved by sustainable development of passenger transport.

Keywords: *sustainable development, sustainable transport, European Union, sustainable passenger transport, environment, urban transport.*

1. INTRODUCTION

The major problem of every economy and society as a whole is sustainable development. We search opportunities of sustainable development in every sector of the economy and especially in transportation area. Making transport sustainable is probably the most challenging aspect of sustainable development, after eradicating poverty.

Regarding the future of global mobility, Schafer and Victor predict that per capita mobility in Western Europe will increase from 10622 kilometres yearly in 1990 to 34022 kilometres yearly in 2050. The authors believe that as we become richer and technology improves, we will travel faster and we will adopt the travel patterns of the future.

Transport is the main activity that affects seriously the environment due to his negative social effects:

- Transport uses especially non-renewable energy resources. At global level, energy consumption for transport will increase by 1,5% per year up to 2030;
- Transport infrastructure and vehicles' production use energy consumption and materials consumption (steel, aluminium, etc.);
- Transport is the principal source of air, soil and water pollutants all over the world;
- Millions of people are killed or injured on the roads every year or are exposed to urban traffic noise;
- Transport and his unsustainable development can affect the quality of urban community life. Disabled people, poor people or immigrants can be the subject of social exclusion. [2]

All these unsustainable trends must be diminished and new policies and practices have to be encouraged in order to meet the goals of sustainable development in transportation.

2. LITERATURE REVIEW

The concept of "sustainable transport" is largely disputed in literature and in practice. It has appeared in 1992 in "Green Paper on Transport and the Environment" and since then everybody's question is: "why we can't reach to make transport sustainable? ".

OECD stated that "a sustainable transport system is one that: provides for safe, economically viable and socially acceptable access to people, places, goods and services; meets generally accepted objectives for health and environmental quality; protects ecosystems by avoiding exceedence of critical loads and levels for ecosystem integrity; does not aggravate adverse global phenomena such as climate change and stratospheric ozone depletion and the spread of persistent organic pollutants."[7]

Holden suggests three ways to achieve sustainable transport: *the efficiency, the alteration and the reduction*. For every pattern, the author presents some policy orientation. *Efficiency* means develop more energy-efficient transport technology, regulate and adapt to the use of this type of technology. *Alteration*, in his model, regards the development of new technology for more energy-efficient modes of transport, regulate and adapt the use of these modes of transport. *Reduction* aims to reduce travel demand through the development of information technology, land-use planning and increasing positive environmental attitudes. The previous approaches can't be successful, unless the governments and other actors that take part in these actions don't make awareness campaigns through population in order to obtain positive attitudes and actions towards sustainable transport.[2]

The promotion of sustainable transport can be realised by reducing energy consumption, developing and implementing new technologies, improving public transport (including cycling and walking), increasing population's positive-environmental attitudes,

encouraging sustainable land-use planning, enhancing information and communication technologies.

3. OVERVIEW OF PASSENGER TRANSPORT IN EUROPEAN UNION

In European Union passenger transportation involves all means of transport, but the main mode of passenger transport is passenger car, with all its well-known advantages. Unfortunately, the intensive use of this mean of passenger transport across the European Union generates many economic and social problems in most European countries, especially in urban areas.

Studying the data presented by Eurostat in January 2016, we can outline the following picture of passenger transport in EU-28:

- The trend of using passenger cars was stable in the period 2003-2013 with shares between 83.0% and 83.7%;
- Motor coaches, buses and trolley buses accounted for 9.2% of inland passenger transport in 2013 and trains- 7.6%;
- The latest data available show that in 2014, 381 billion passenger-kilometres travelled on national railway networks of the EU-28 and 22 billion passenger-kilometres travelled on international journeys;
- EU member states carried by sea 400 million passengers in 2013. Greek and Italian ports ranked the first places with 75 million and 72 million maritime passengers in 2014;
- 880 million passengers travelled by air in the EU-28 in 2014. The biggest number of air passengers in 2014 was 73 million on London Heathrow Airport, followed by Paris Charles-de-Gaulle Airport with almost 64 million.[12]

Table 1. Total number of passengers carried by the 15 top airports in EU-28 in 2014

-million passengers-

Airport	International	National
London Heathrow	68,1	5,3
Paris Charles-de-Gaulle	57,9	5,8
Frankfurt	52,7	6,7
Amsterdam Schiphol	55,0	0,0
Madrid Barajas	29,4	12,1
Munchen F.J. Strauss	30,3	9,3
Roma Fiumicino	26,8	11,4
London Gatwick	34,4	3,7
Barcelona	27,1	10,3
Paris Orly	14,8	14,0
Kobenhavn Kastrup	23,7	1,8
Palma de Mallorca	18,0	5,1
Wien-Schwechat	21,9	0,6
Stockholm Arlanda	17,4	5,1
Manchester	19,5	2,5

Source: ec.europa.eu/eurostat, 2016

Passenger transport has serious impacts on the environment within resources consumption, land use, greenhouse effect, acidification, eutrophication, toxic effects on humans and ecosystems, summer smog, noise. For every major environmental impact statistics uses indicators like: PEC (primary energy consumption for resource consumption), CO_2 (carbon dioxide emissions for greenhouse effect), NO_x (nitrogen oxide emissions for acidification, eutrophication, human toxicity, eco-toxicity), NMHC (non-methane hydro carbons for human toxicity, summer smog), PM (exhaust particulate matter from vehicles for human toxicity, summer smog). [6]

According to Eurostat, transport recorded the biggest share of NOx emissions. Analysing the economic activity in European Union and the impact of the main sectors of the economy on the acidifying emissions, data presented by Eurostat revealed that transport is the second area of activity with a share of 21% (4,2 million tonnes of SO_2) of total acidifying potential after agriculture, forestry and fishing industry with 36%. [1]

Data for the relation between final energy and primary energy (efficiency) and emission factors related to final energy are showed in the table below.

Table 2. Emission factors and energy efficiency of fossil fuels for energy production

	Efficiency	CO_2(kg)	NOx(g)	SO_2(g)	PM(g)
Gasoline	75%	0,67	2,2	6,2	0,30
Diesel	79%	0,47	1,8	4,4	0,24
Kerosene	79%	0,45	1,8	4,3	0,23
LPG	83%	0,54	1,8	5,0	0,24
Marine Diesel Oil	79%	0,40	1,7	4,0	0,22

Source: [6]

4. SUSTAINABLE PASSENGER TRANSPORT IN EUROPEAN UNION

There are many policies that focus on achieving sustainable passenger transport, but the most effective ones are those which aim to develop new technologies and to change travel patterns. A special attention must be oriented to leisure-time travel than to everyday travel. One of the strongest reasons for this is that leisure-time travel accounts for more than half of total energy consumed and CO_2 emitted in passenger transport. [2]

4.1. Solutions of making passenger transport sustainable

One solution could be the introduction of “inducement prizes” to reward the best innovation of new low-carbon technologies in transport (for example, zero emission vehicles).

Another solution stresses the important role of cycling and walking in the development process of sustainable passenger transport. European Parliament wants to develop a 50-year plan for promoting cycling in all member states of the European Union.

A good option is also the stimulation of people awareness through information campaignes about the

negative effects of leisure-time travel on the environment, especially by car and plane. For example, "by flying abroad once a year, you use as much energy as you do for your housing needs for the whole year". [2]

Introduction of information and communication technologies to facilitate public transport, in order to find a database on telephone or by searching the Internet with schedules for all public transportation systems is a good model, successfully implemented by the Dutch system. This solution encourages also a "clever behaviour" of the passenger, who can combine car and public transport until he arrives to the final destination of his travel.

Congestion charges are one of the best solution for European Union cities, because this measure contributes to the reduction of CO_2 emissions, to the diminish of congestion, especially in the beginning and end of holidays. This measure also reduces the number of traffic accidents and boost the options of passengers for more eco-friendly modes of transport.

Another approach that can assure that sustainable passenger transport happens is the introduction of CO_2 – differentiated tax on new cars. Due to this method consumers will be focusing on purchasing smaller and low-emission cars. In several countries, for example Norway, the population feels the effects of this approach.

4.2. Best practices of sustainable passenger transport in European Union countries

One of the best examples of good practice is *car-free residential area*, which is the neighbourhood free of or with reduced car traffic. In this area car parking is not allowed, so there is less air pollution and noise, more green spaces and more safe for children. This type of areas can work if they permit an easy access to public transport network. Examples of such areas are in Cologne-Nippes and Freiburg-Vauban.

Combined mobility is a solution that can resolve all transport needs with one product – one card. Passengers can use all public transport modes combined with supplementary transport services, like: taxi, bicycle, carsharing, etc. Public transport company „USTRA" in Hanover, Germany and the private company "Mobility Mixx" in the Netherlands used this concept. The final target of all this actions is to eliminate the need for employees to use their private car at work.

Related to this practice, bicycle stations are an important part of combined transport. These stations establish a proper link between people's homes or workplaces and the public transport. A good example are 100 bicycle stations established at railway stations throughout North-Rhine Westphalia. The largest bicycle station is in Germany (Munster) and it has the capacity of 3300 places. This underground station is modern, safe and offers suplimentary services like: repairs, washing, rental, etc. The bicycle is a sustainable transport mode because it doesn't harm the environment, it doesn't cause CO_2 emissions. It is a clean way of transport for short journeys.[4]

Cars can be as always the most favorite mode of transport, only if they are "*environmental cars*". An "environmental vehicle", according to the Gothenburg Council definition can be: "electrical vehicle, electric-hybrid vehicle, vehicle that can operate on natural and biogas, vehicle that operates on ethanol, extremely fuel-efficient vehicle running on regular fuel such as petrol and diesel (maximum 5,2 and 3,4 l/100km)". The Gothenburg Council gives this definition because it uses 2400 cars, of which 50% are environmental cars, so he is an exceptional example in this field, a leader that has to be followed.[4]

4.3. Measures for sustainable urban transport

The United Nations Economic Commission for Europe (UNECE) gives a series of recommendations to European countries in order to increase the sustainability of their urban transport systems.

First of all, UNECE outlines that public transport should offer more than one option of service and these should be well interconnected with each other. It should also offer adequate accessibility. [11]

Another important recommendation regards the adequate comfort that public transport could offer (clean, low-floor and air-conditioned vehicles), the real-time information displayed for passengers in vehicles and at the stations and various passenger-friendly options of ticket purchase.

One of the essential UNECE recommendation refers to the development of a safe public transport, by limiting the risk of fatalities and injuries to nearly zero.

Last, but not least important, cycling and walking must be included in sustainable public transport development plan. These forms of transport should be encouraged through availability of adequate and safe infrastructure and through a good liaison with public transport.

5. CONCLUSIONS

The passenger transport system in European Union is characterized by the predominance of road and air modes of transport. The intensive use of passenger car across the European Union generates many economic and social problems in most European countries, especially in urban areas.

Due to this reason, a special attention must be oriented to leisure-time travel than to everyday travel, because leisure-time travel accounts for more than half of total energy consumed and CO_2 emissions in passenger transport.

The paper presents certain solutions to make passenger transport sustainable, some examples of best practices in this way and a few recommendations to increase the sustainability of the European urban transport systems.

Passenger intermodality can also contribute to the development of sustainable passenger transport. The main objective of modality is to offer the passenger the opportunity to go "door to door" and comfortable. Intermodality can help to develop an integrated and efficient transport system, allowing a rebalancing

between different modes of transport and provide passengers with a wide range of options.

Special attention is given to interchanges between rail and air transport, rail transport representing the source of passengers for air transport and urban transport. Automobile and urban public transport are important for travelling long distances especially in the transport of luggage.

Analysis of current practice shows that the technological base is already well advanced to support passenger intermodality. Through the development of advanced technologies (for example, mobile becoming cheaper with color displays and GPS), technologies of transmitting/broadcasting media such as Digital Audio Broadcasting (DAB) services, intermodality will be of higher quality. The actual technical phase should encourage the development of information systems for intermodal real-time high quality of ticketing systems with smart card, reserving and purchasing of tickets, as well as the development of baggage transport systems "door to door".

Multifaceted support by the political factor becomes increasingly stronger, but successful implementation strategies are less visible. The fragility of implementation is mainly due to the serious problems of coordination and cooperation of legislative and regulatory matters, funding and resources for effective implementation of standard solutions in design that meets real user.

Candidate countries and new EU members also face other specific problems due to the lack of public resources, the quality of existing infrastructure and the rigid structure of the institutions. The last two issues are of major importance in the development of intermodality, for which they have been given special attention in the national inventory stage.

Difficulties in integrating European systems are compounded by differences in language and currency exchange, as well as the increased level of problems in coordination, legislation, funding and standardization.

There were formulated some recommendations that the European Union will consider in its work program.

Concluding, sustainable passenger transport can be realised by reducing energy consumption, developing and implementing new technologies, especially for cars (environmental cars), improving public transport (including cycling and walking), increasing population's positive - environmental attitudes, encouraging sustainable land-use planning, enhancing information and communication technologies.

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THE MARITIME TESTAMENT IN THE NEW ROMANIAN CIVIL CODE

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ABSTRACT

The purpose of the present study is to highlight and analyze the set of rules that govern the maritime testament according to the new romanian Civil Code. Because of the specificity of life at sea and on board ships, the maritime testament follows special rules and exceptions, different from the standard ones applicable to an ordinary testament. Indeed the special flow of life and work at sea and on board ships in generally dictates the practical need for a kind of regulations similar in their finality but different in content. The present paper has three chapters as follows: in the first chapter we analyze the place of the maritime testament in the field of the privileged testaments, according to the romanian Civil Code. The second chapter contains the set o rules applicable to this kind of testament. The last chapter refers to the probing force or the maritime testament.

Keywords: *Maritime testament, rules, privileged testaments.*

1. THE MARITIME TESTAMENT. A PRIVILEGED TESTAMENT

Not frequently founded in the judicial practice, the privileged testament also known as the authentic simplified testament (1), plays an important role in those situations where the elaboration of such acts may be different from the normal standards of life.

There are four types of privileged testaments, according to the 1047 article from the new romanian Civil Code. A short presentation of all of them it is needed to compare the cases in which they can be made. The first type of privileged testament is it known in the judicial literature (1) as the testament of the extraordinary situations. This testament can be made in front of the competent officer from the civil local authority in case of a plague, catastrophe (for example a nuclear incident, highly flooding, earthquakes) war or other similar exceptional situations. In the special juridical literature (1), an opinion was issued in the sense that by competent officer from the civil local authority we may understand firstly those who have juridical training, for example: the council secretary, the secretary of the county council, the mayor or the prefect. We think that in the list may be also included the jurist from the city hall or from the civil status authority. Also in the juridical literature was stated that only if in that local area there isn't any public notary office available (2), the testament of extraordinary situations may be done.

The second type of privileged testament refers to the naval and aeronautical testament. Three conditions must be fulfilled: first the testament must be made in front of the captain of the ship or the one that substitutes him (normally the chief officer or the second or third officer). Secondly, the ship must be under romanian flag. And thirdly, the ship must be engaged in a maritime or fluvial journey.

The same equivalent conditions apply to the aeronautical testament. The airplane must be operated by a romanian company for the effects to be recognized.

There can be some situations in which a person (the testator can be a crew member or passenger, including stowaway) is funded (on a vessel sailing in the middle of the ocean) and because of different reasons (for example he or she may dye in short time) may want to testify but not only by hand written, but in the presence of an authority representative (the captain of the ship or the crew member which substitutes him). We reckon that assimilated situations can be when a person makes a testament, in the same conditions, but on a submarine under romanian flag, or on a balloon operated by a romanian company. Also it is best to notice that the voyage can be on a river, not necessary at sea, or at anchor, not necessary en route.

In our opinion it is debatable whether the rule applies if the ship is moored in a port. Having in regard the principle ubi lex non distinguit, nec nos distinguere debemus (where the legislator does not distinguish, neither should we distinguish (3)), we can state that the ship is in voyage interval when operating (loading or discharging), so the rules seem to apply. De lege ferenda we propose that this general rule should be changed and follow the final thesis from the following paragraph. Therefore in the future a revised Civil Code would have in consideration the reality of the situation: if the mariner can reach a public notary, it will not necessary for the testament to be done in front of the ships captain.

In the juridical literature (1) it was mentioned that the testament must be made in compliance with the internal company policies and also for the persons to speak romanian language. The last condition can be difficult to fulfill when there are different nationalities on board, on a ship under Romanian flag. Still it is not excluded exempli gratia for a french passenger to know romanian language. But we cannot approve this opinion mentioned by the juridical literature because these supplementary conditions are not stated in the Civil Code.

The third type of privileged testament refers to the situation when it is made in front of the commander of a military unit or the one who substitutes him, if the testator is a soldier or without having this quality is an employee or services within the romanian armed forces. Another condition is that the testator cannot address to a public notary. In the special juridical literature (1) this

kind of testament is also known as the soldiers testament. Such situations may be when the testator is in a concentration camp, long missions (ex UN peacekeeping missions) or in ongoing wars.

The fourth privileged testament is the testament made in front of the director or the chief doctor of the health institute or the chief doctor of the service or, in case of their absence, to the doctor on call, while the testator is hospitalized to a health institution in which the notary public has no access. Again as we can notice there is a common aspect: the person who makes the testament cannot go to a public notary nor can a public notary reach the testator. In the special juridical literature (1) it is noted that it doesn't matter if it's a public or private hospital, and such situations may be when a quarantine it is instituted in the sanitary institution.

2. COMMON RULES WHICH APPLY TO ALL THE PRIVILEGED TESTAMENTS

The maritime testament as well as the other privileged testaments must be done in a written form, but not necessarily by the own hand of the testator, this not being the case of the (ordinary) hand-written testament. Also it is necessary to make the testament in the presence of two witnesses. Having in consideration the principle ubi lex non distinguit, nec nos distinguere debemus (where the legislator does not distinguish, neither should we distinguish (1)) the two witnesses may be crewmembers (for example: one deck officer and one engine officer), passengers or even stowaways.

The maritime testament must be signed by the instrumentating agent (the captain or the responsible officer that substitutes him), testator and the two witnesses. If the testator or one of the witnesses can't sign, a mention will be made on the testament regarding the cause that stopped the person from signing. These provision are stated under the absolute nullity sanction. For example, if only engine officers survive a maritime incident, a maritime testament can't be legally made. And what if, in the last example, an engine officer decides to make a testament in front of the chief engineer? Would that testament be valid? Only if the testament if hand-written, dated and signed by the engine officer, the answer to the question can be founded in the 1050 article from the new romanian Civil Code which states that a testament hit by nullity can produce effects if it meets the conditions provided by law for another testament form. Thus, although the testament will be null as a maritime testament, it can be recongnised valid as a hand-written testament, with all the rules and effects applicable to this kind of testament. This is known as the conversion principle of the juridical papers, an exception from the the principle quod nullum est nullum producit effectum (what conventions are hitted by the nullity sanction cannot produce any effects).

If the captain wants to make a maritime testament, he or she shall make it in front of the officer that legally substitutes him (chief officer, second officer or third mate).

We believe that a maritime testament cannot be legally done in front of just one (eye) whiteness even if it is mentioned on the testament the reason why the other whiteness could not sign (for example it is gone missing). In this case in the situation of a case in court, the instrumentating agent may also be examined as a whiteness, having in regard the latin principle testis unus testis nullus (with only one whiteness there can be no testimony), but the testament will be valid as an hand-written testament, not a maritime one.

Another common rule which applies to all privileged testaments (including the maritime testament) refers to the lapse effect (an inefficacy cause, meaning that no effects can produce). Thus, according to the first paragraph from the 1048 article from the new Civil Code, the possible effect is that the privileged testament will lapse if 15 days had passed from the point at which the testator could have testate in one of the ordinary forms. This term is suspended if the testator is in a state which don't permits him to testate. The 15 days term starts from the day at which the mariner had come back from the voyage.

The rules shall not apply if there is a testamentary provision in which a testator recognize a child, this being the only exception. The reason for why the legislator had provided this exception is that it is in the superior interest of the child so that he or she can be recognized and eventually legally maintained. Also the probation in this case isn't difficult.

We highlight that the romanian civil legislator had chosen the reasons for when the 15 days term can suspend and not interrupt. Having in consideration the exceptional reasons for why could this term can suspend, de lege ferenda we propose that the term should interrupt for these reasons and not suspend. These reasons refer to the major force situations and the fortuitous case. The legal definition of the major force can be founded in the 1351 article from the new Civil Code, this being an external event, unforeseeable, unavoidable and absolute invincible. Exempli gratia we can mention earthquakes, major flooding, wars or environmental accidents.

The fortuitous case is legally defined in the same legal text, at the third paragraph as being an event that cannot be foreseen or prevented. As an example we can mention the situation in which a yacht has a blackout and the person, who previously done the maritime testament, gets stranded for days in open waters.

The reason why the the romanian civil legislator had provided the lapse of effects for the maritime testament has to do with the extraordinary situations in which it had being made. Indeed, we have to take in consideration that the special situations mentioned dictated the need to make a testament and if these situations ceased to exist, then the legislator had absolutely presumed that the testator may had changed his mind. We remind with this occasion that the principle nulla presumptio sine lege (the legal presumptions ore limited by law) is applicable in this case.

Another common rule for all privileged testaments (thus including the maritime testament) refers to the rule from the "opening" of the hand-written testament are applicable (1047 article 4th paragraph corroborated with 1042 article – the opening of the hand written testament). Thus it is mandatory before the practical execution of the maritime testament so that it shall be presented to a

public notary which will apply a visa so that the testament cannot be changed. In inheritance proceedings, the public notary shall, under the special law, open the maritime testament and validate it by putting it in the succession file. The opening of the maritime testament and the state in which it is found will be recorded. Persons interested may get after the visa apply, on their own charge, legalized copies from the maritime testament.

After finishing of the inheritance procedure, the original maritime testament will be given to heirs according to their own agreement, and if no agreement is signed, to the person designated by the court order. In the special juridical literature (1) it is mentioned that the "opening" procedure shall apply if the death of the testator had occurred in the 15 days validity period of the maritime testament.

The reason for why these rules were adopted by the romanian civil legislator is that the maritime testament (like any other hand-written testament) may be conserved for future analysis. This is a sine qua non condition in the inheritage procedure, because the public notary may notice some aspects which can violate the law and thus make the testament invalid. In the juridical literature (1) it is noted that the public notary must refuse to continue the procedure from the moment he observes a law violation problem. Any further debates between the successors must be resolved by the court.

These mentioned provisions are a confirmation of the rules which are stated in the Law nr. 36/1995 regarding the public notaries and their activity. Finally it is best to note that although in the juridical special literature it is stated that there is no sanction for breaking these rules because they are recommendation rules, we believe that having in consideration their imperative connotation a sanction must exist. Therefore, we believe that the inheritage certificate must be hit by the absolute nullity sanction.

Another common rule, that is important to highlight, is the special incapacity that can occur in the maritime testament field. Thus, the testator cannot make the maritime testament in the benefit of the instrumentating agent or one of the witnesses (according to the 991 article from the New Civil Code). If donned otherwise, the sanction that will be applicable is the relative nullity. In the special juridical literature (1) it is noted the symmetry of the relative nullity sanction, which applies to the special incapacity for receiving and/or disposing. The enumeration comprised in the legal text mentioned is restrictive, having in regard the latin principle: exceptio est strictissimae interpretationis (the exceptions are for strict interpretation) (4). This means that for example that an engine officer could testate in the benefit of the chief engineer if the last one is not a whiteness mentioned in the testament. The reason for why the romanian legislator had provided these rules is because an absolute presumption of influence and authority that the instrumenting agent may have on the testator, making the last one more vulnerable.

3. THE PROBING FORCE OF THE MARITIME TESTAMENT

When dealing with a court case regarding the maritime testament it is best to know what are the limits in which a maritime testament can be believed as being true, having in consideration that actori incumbit probatio (the complainant must proof his claims). We have to distinguish between what was written by the instrumented agent and not. As mentioned, not being a hand-written (ordinary) testament, the personal provisions may be written by the instrumentating agent.

We believe that if these provisions are written by the testator, then the probing force of the maritime testament are the same as for any other paper under private writing, thus they are true under the contrary probation (any evidence will be accepted to overturn the presumption). As for the mentions made by the captain, regarding the special conditions or the impossibility of a whiteness to sign, a more rigorous evidence will be needed. It will be necessary to probe that the statements made are false a for criminal complaint to be done and afterwards a court decision to prove that the provisions made by the captain are false.

Having in consideration the juridical doctrine (5), we believe that is mandatory to log the testament event in the logbook and also the circumstances that determined the person to make the testament (a severe injury, illness etc.). This is one of the reasons why it's the masters duty to assure that the officers and the crew are aware of the importance of the logbooks and taking care when making entries.

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THE OPPORTUNITY OF FOUNDING FISCAL COURTS

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ABSTRACT

A good law is the one that is being obayed and the one that reaches its objectives for which it has been elaborated. No matter how accurate the laws are, if the state machine that has the obligation to apply them does not fulfill its duties effectively, the expectations of the legislator can not be achieved. In Romania, in most cases, the law is not bad but rather its application has many flaws. For the implementation of legal norms, the State created a specialized unit that focuses on economic and social life fields. A specialized unit is essential for capturing all the details of certain activities – identifying its week spots and helping to improve the rule of law. Thus, for ensuring the observance of rules derived from criminal law, there are departments or institutions such as: police, prosecutors and courts of law. For civil law there are also interinstitutional relations. Criminal offenses appreciated as being serious and with special social effects ''enjoy'' special attention from the specialized agencies of the State. We appreciate tax evasion or tax fraud as being equally harmful and serious in both economic, social or political areas. Considering evading tax payment as a circumvention of the law, we think that it would be proper the existence of a interconnected system for the application of fiscal law alongside the existing tax system.

Keywords: *Fiscal courts, tax evasion, financial evolution.*

1. INTRODUCTION

Any specific activity of a particular industry needs Ministry of Finance is the state institution responsible for applying the rules of law to all citizens that have taxable incomes. This institution promotes fiscal rules that are submitted to legislative approval.

Also, the Ministry monitors the rule compliance by all those who are implied in the system.

The ''conflicts'' that appear between the taxpayers and state representatives are a subject for a conciliation process that is developed on several levels and steps.

Therefore, a taxpayer that feels wronged in fiscal terms (referring to the payment obligations that have been imposed) addresses, in the first instance , to the one that issued the receivable title. The complaint will be redelivered to an Office of Claims Settlement within the territorial tax unit . A second court is the administrative contecious in the local court, followed by the tribunal , by the Court of Appeal and finally by the Supreme Court. When the solution is final and irrevocable, the taxpayer is obliged to comply with it. During this period, usually, the execution of the fiscal administrative act is not suspended. In this context we believe that we need a specialized court, to ensure prompt and impartial settlement of complaints made by the tax payers to fiscal administrative acts.

2. FISCAL COURTS - LEGISLATIVE REFEREE BETWEEN THE STATE AND THE TAX PAYERS

We consider the founding of fiscal courts as being necessary and opportune and that ths measure cand bring advantages not only in the fiscal system but even in maintaining a favorable climate of developing effinciently and with high pragmatism fiscal relations between tax payers and the state.

The necessity of founding the fiscal courts is derived from the following considerations:

1. The need to reduct or to eliminate the subjectivism in judging the taxpayers complaints;

Any contested tax decision in the first instance has almost no chance of winning for the one who made it. The subjectivism of the fiscal system, when it comes to the ''decision unit" is functioning in the virtue of a well known resort. In these conditions the solution of rejecting a contestation causes bigger dissatisfactions when it is maintained, without clear explanations both the facts and the legal classification. We are refering to the cases when the action performed by inspectors can be classified as being tendentious. This type of subjectivism can be manifested both in favor and in disadvantage of the taxpayer.

When the tax payer is '' favored" by the fiscal inspectors he does not file a petition to the court because he has no interest to lose what he won in such a manner.

A fiscal court is qualified to judge with professionalism , discernment and celerity every case, to issue a reasoned solution unaffected by subjectivity. The fiscal court must be a neutral institution.

2. Relieving the courts of a significant part of pending cases

Representatives of the ministry of justice are often complaining that they are ''suffocated'' of the high number of pending cases. From this ''total'' of cases, a significant part have , as a subject, economic and fiscal conflicts. This type of cases need a higher amount of time to be solved because of the accounting and financial expertises, the hearings of a significant number of people, and also beacause of the high stake that it is in the game.

On the other hand, after EU integration, the casuistry is bigger and more complex because the law

principles from other states interfere (after the economic iteractions), but even the diversification of the manifestation of tax fraud is an issue that must be heeded.

3. The specialization of judges for economics and fiscal fields

We do not contest the courts professionalism, especially the judges who run these lawsuits of economic or fiscal nature, but no matter how capable they are, the volume of work that they carry is beyond human limit. We can not claim objectivity from them concerning fiscal issues. After a theft case , two divorces, robbery cases, etc. it is beyond their human limit to give an objective solution to a fiscal problem.

4. The ‘’privacy’’ of taxpayers

To taxpayers, as parts involved in the law process, respecting the privacy of their business is highly important. In the present law system , the lawsuits are carried with the ‘’doors open’’, in an colorful mix of cases and individuals such as: lawyers, prosecutors, involved parties, assistance, but also business competitors. Even if, till the final sentence, the so called escapist must be considered not guilty, his etiquette as an honest citizen suffers, but also his economical status- at least in front of his economic rivals. Why? Because the assistance brings the so called escapist an image injury, and sometimes even his business has to suffer. There are a lot of examples in this area that were highly publicized, even if the final sentence proved the lack of guilt of those acused. Who pays for these ‘’losses’’? We agree with the publicity that concern cases of tax evasion, but these cases must be certain to receive definitive solutions. This is a practice of states with consolidated tax systems and where fiscal courts were founded.

The opportunity of opening fiscal courts can be appreciated by: Romania's EU accession.

Romania had succeeded partially the reform of the tax system when the accession to EU took place. Member countries with consolidated tax systems, verified in time, have a higher capacity of supporting changes in the European fiscal policy plan. But a fragile system as ours can not take easily new evolutionary currents in fiscal areas, often risking major distortions and malfunctionings that are hard to overcome.

The opening of European markets for Romanian companies, foreign massive capital inflows, are performed against a background of more and more pronounced interactions with the European tax cultures and not only.

Learning fiscal behaviors of European citizens by the romanian citizens is not a task easy to accomplish and viceversa. In this context, the misunderstandings in the economic business field are inevitable, but they must be solved by a civilized manner. This is also because Romania needs a good image in order to comfortably stand among other nations at the European table. The state representation, as is done at present, has a great handicap in reaching this goal. The staff from fiscal units, often underpaid, with a childish behavior and with a lack of professionalism when it comes to solving conflicts on fiscal matters, can contribute in an unwanted way at damaging the image and even chasing investors. This interface between the state and the tax payers has a great impact on the state image that is supposed to be in the service of citizens. Based on the above considerations, we think that the decision of opening fiscal courts is highly neccesary, more needed than ever, and it depends only on decision-maker factors.

3. A NEW STEP IN FINANCIAL ACTIVITY-EVOLUTION

The need of normality in every field, especially in the economic area, where the ‘’ seizures’’ are great., it is expressed by the factors involved in reaching this desideratum: the state and the tax payers.

Every citizen has the need of knowing that his rights are respected, so that he can manifest his freedom of thinking and ecoonnomical action, and that these rights are guaranteed by justice. That is why, among time, justice was the factor that takes care of maintaining social order, but also economical and political order.

In the last years, Romania entered in a new evolutionary stage concerning the consolidation of the market economy, especially the fiscal reports., capturing new values that bring hope. If we refer at the fact that in the mind of the many tax payers the fear of fiscal control has vanished, we can say that we are on our way of a full democracy in the tax area.

We support that between the state and the tax payer the relation should be basesd on professionalism, competence, honesty, and fairness. The tax payer must be aware of his rights, and when he feels that his rights are not being respected he must know that he has a fair way of defending himself. But also, when he made a mistake he must be sure that he will be punished by law. Therefore, we have a very importaint step to make: the accountability of those responsible. If for breaking the fiscal law the guilty tax payers must stand the rigor of the law, those that make an abuse in carrying out their duties shoul also pay. This stage can not be reached in any condition. We need specialized and neutral institutions where objectivity must be a priority.

The advantages of opening a fiscal court, from our point of view, are multiple. They can be better highlighted if we start from the ways the relations between the state representatives and the tax payers are developing.

A. Fiscal courts –a factor of stability in tax relations between the fiscal system and the tax payer.

The practice of fiscal control show that the present legal system can not respond in terms of efficiency at judging cases of tax evasion. This statement is based on the following aspects:

- The lack of specialized staff in the legal tax area
- The complexity of the facts that concern tax evasion
- Social and economic danger of tax evasion
- Significant financial effects of tax evasion
- the number, diversity and complexity of cases in courts
- the high amount of time spent in judging these cases

There are situations when, even if the tax evasion was proven and quantified, the bad intentions of the acts

were proven, the solution of the case was favorable to the escapist. This situation is possible due to the principles of judging taken from the civil law.We can mention the case of some trading companies who used false invoices in order to obtain value added tax refunds. The court concluded that the concerned tax payer is a bona fide purchaser. By this verdict was in fact regulated a grossly theft based on a forgery and use of forgery and we can afirm that the court interceded for a money laundering. On the other hand, the verdicts, often arbitrary, issued by the current courts, are factors that instigate to tax evasion – favorable for those with a good financial situation and and detrimental for those with lack of funds.

We must appreciate that the existence of a functioning fiscal court implies certain amount of work and public spendings. We consider that these spendings can be recovered if the tax evasion cases are treated with professionalism so that the stolen funds from the state treasury are recovered and the the phenomenon of tax fraud will be reduced.

Romanian tax system modernization and and its functioning based on principles of efficiency and increased efficiency requires the establishment of fiscal courts.

The organization of these institutions should be beneficial for: the state, tax payers and for certain categories of persons who carry out liberal activities (expert accountants, financial auditors, jurists).

Let us take them one at a time:

For the state:

- an uniform application of tax legislation by the fiscal apparatus is ensured. The existence of fiscal courts will impose the development of procedures and perfected work techniques starting from the fiscal procedure code.
- The cases, once judged, with a final and irrevocable solution, could become working regulations for the fiscal apparatus. Therefore, the sentence issued for a certain case will be applied for the future cases that have the same object and mode of action
- legislative deficiencies can be seised following legal professional rules and correction proposals can be made in a pertinently and operative way. The solutions of fiscal courts could be a real support in the phase of modification normative acts with fiscal nature, or even when new acts are promoted.
- shortening the hearing of cases of a fiscal nature and the recovery of amounts evaded. In terms of inflation, the recovery of the defrauded amounts in a depreciated currency it is treated as a budgetary loss.
- Measures of enforcement procedure can be taken in due course, before the material procedure is taken away.

For the tax payers the advantages can be materialized in:

- verdicts of the fiscal court, better argued, with a lower grade of interpretation, more objective, easier to accept compared to the verdicts of current courts.
- cases judged by magistrates specialized in fiscal law, where the arguments pros and cons wll be measured with professionalism, and the sentence will be given in the spirit of fiscal law.
- The fiscal law courts will not allow the fiscal apparatus to interpret legislation in the detriment of the tax payer
- The litigation costs will be lower reducing the number of courts.
- The evidence provided in court will be assessed within the same legislative context which was the basis for tax evasion. The fiscal court will be the place where the fiscal law will be debated by professionals on the matter, and the final results will be objective.
- The tax payers will be able to choose specialized staff in the fiscal area from fiscal offices that can represent them in court. At a higher offer, the costs will be acceptable.
- The number of honest tax payers will grow.

For persons who carry out liberal activities in the following areas: financial, accounting,fiscal, or juridical, the founding of fiscal courts can bring:

- The founding of fiscal law bars which will be composed by: lawyers, tax consultants, financial auditors, expert accountants, accountants, jurists
- specialized personnel from the fiscal apparatus can choose between continuing as a public servant or exercising a liberal profession.
- specialized workforce will be attracted to the fiscal centers, where there will be fiscal courts.
- The competition between the fiscal bars will increase the work quality in the fiscal area.
- The debates between the fiscal lawyers and fiscal magistrates will lead to issuance of right solutions regarding fiscal fraud

These arguments can at least represent a starting point in taking political decisions concerning opening the fiscal courts

4. CONCLUSIONS

Outside the European Union (EU) fiscal courts are spread, both in developed countries like the US or Canada and also in developing countries such as those in Latin America or Russia. In the EU, Britain, France, Germany and, recently Bulgaria have introduced specialized tax courts. The effect was that the time spent with the process was shortened and the miscarrieges of justice were reduced. But in most European countries in which there is such a specialization(tax and fiscal law), there are sections, panels or judges specialized in administrative law and fiscal law (not strictly fiscal), that take care of trials which concern fiscal matters.

Certainly courts in tax litigation are required. The more so as Romania had such organs specialized in jurisdictional tax which included a judge in the interwar period (even if the tax courts were not per se). So we have a tradition regarding tis matter, and several European countries, including France, Germany and recently Bulgaria, have successfully introduced such specialized courts, which shorten the processes and are better versed in the issues concerning tax laws.

The discussion about the existence of at least some courts or judges specialized in tax law has existed since

the early 90s when the foundations of the tax system was laid in Romania. Taxpayers and tax specialists felt the need for judges who know how to divide justice and who understand fiscal matters and can bring "fine nuances" of cases received for settlement. Unfortunately this was not possible and long tax disputes were the responsibility of judges who dealt in parallel with divorce, partition or processes for common law offenses.

In conclusion, Romania needs specialized courts in tax matters and Judges "certified" in tax law that understand such cases and who can reduced the time spent with this cases and the risk of miscarriages of justice resulting from misunderstanding all legal aspects relevant in cases very complex.

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ANALYSIS OF THE RISK IN THE PROCESS OF INTERNAL AUDIT

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ABSTRACT

Risk analysis has become in recent years an increasingly widespread practice in all fields, serving in choosing various possible options within them. Macro models for evaluation have been developed, incorporating models for managerial options, being complex interactions between these components and feedback relationships. In these conditions every manager is encouraged to become its own risk manager.

Keywords: *Risk assessment, auditors, criteria.*

1. INTRODUCTION

• Risk analysis is a process in which gross risks resulting from risk identification process are grouped, filtered and prioritized. The purpose of this activity is to provide detailed descriptions of organization risk, so that scenarios concerning the higher risks and the actions most appropriate for risk control can be planned and implemented in the next step of the risk management cycle.

• Risk analysis is a dynamic and active process through which the risks are identified, analyzed and evaluated, so that they can provide a basis for future management decisions.

• Risk analysis is not an exact science. By establishing control activities, risks are aimed to become medium or low, to extinction. However the risks must ''evolve'' downwards.

Analysis / assessment of risk is an important stage in the activity of auditors and it is performed for:

- Developing a plan and an audit program
- Establishing audit objectives
- preparing, updating, assessment of the risk register

2. RISK ASSESSMENT METHODOLOGY FOR PREPARING THE INTERNAL AUDIT PLAN

Internal audit is an activity plan based on risk assessment attached to auditable activities, according to law. Under these circumstances, public entities elaborate a multiannual plan 3-5 years to audit all departments / activities / functions / programs within the entity of which is allocated to the annual internal audit plan. For each mission in the annual work plan is developed an intervention program on the spot by the team of internal auditors.

Risk analysis is a very important procedure used in internal audit missions, for identifying activity risks developed in an organisations that can affect the performance of achieving its basic goals. Based on analyzing the risks, internal auditors will audit only those activities with a high risk, possible with medium risk, in the process of risk analysis conducted in preparation of an internal audit mission.

In this material is developed a risk assessment methodology for the preparation of internal audit, in accordance with the regulatory framework in force in Romania, establishing the number of units to be audited annually depending on the risk analysis, depending on each entity that it is to be audited, based on the same procedure of risk analysis .

Basedand on risk assessment of the risks associated with the audited activities, it was established an order of priorities of the internal mission audit based on the risks that will come in auditing and which will be reflected in the internal audit plan for the current year.

3. ESTABLISHING THE NUMBER OF UNITS THAT WILL BE EXAMINED BASED ON THE RISK ANALYSIS

Within the competence there are 30 public units - tertiary authorizing officers and annually may not be heard more than 10 entities, due to fewer auditors hired to audit.

From this point of view it is necessary, based on a risk analysis to be performed, 12unitis with high and medium risks must be selected , depending on the risk criteria that are taken into consideration within this analysis. The method used for analyzing risks is the matrix method of appreciation, starting from the appreciated risk criterias their weights.

The stages will be as follows:

a. Establishment of criteria or risk factors for the unit.

In this case, the risk criteria (Ci) established are as follows:

• controls performed on the entity in the last 3 years- C1

• fluctuations in personnel departments that will be audited – C2

• the period of audit- the date of the last audit- C3

• existing departments reported to the appropriate entity and auditing areas - C4

• the existence of qualified human resources – C5

• the entity that will be audited must provide materials and calculation techniques needed foor solving the tasks- C6

• complexity and volume of tasks performed- C7

• the number of persons employed to perform the work tasks -C8

- the involvement of general managers in providing for the hired staff so they can accomplish in good conditions their work- C9
- the existence of a request from the unit for auditing before the term of 3 years – C10

b. Score attribution (percentage) per each risk criteria, this being determined by the auditors based on existing data , the score is from 1 to 100.

For each risk criteria a risk percentage is established – for example for C1 they give P1 up to C10 to P10

c. Attribution of grade from the auditors (Nci) from 1 to 3, specific for each risk criteria:

- Grade 1-
- Grade 2-
- Grade 3-

d. Determining scores or percentage for each risk criteria attributed (Pci) to the organization

This is determined by by weighting the grades (Nci) with the percentage attributed for each criteria(pci) after the formula:

Pci = Nci x pci where:

Pci= percentage for each criteria

Nci= the grade recived by each risk criteria

pci= the wight attributed for each risk criteria

e. determining the total score of the audited unit (Tpc), by summing up the score obtained from all criteria the risk criteria, as follows:

Tpc= Pc1+Pc2+Pc3+…..+Pc10

f. framing the total score obtained for all for risk criteria (Tci), in the class of intervals established for the determination of the types of risks, as follows:

Scoring range: (1,00 – 1,66) results a low risk

(1, 66- 2,34) results a mediun risk

(2,35- 3,00) results a high risk

g. Risk ranking by the absolute ranking method, for each audited unit based on the total score for all the risk criteria.

We will give an example of the present methodology for establishing the units that will be audited in the current year:

A. Establishing the risk criteria for determining the audited units:

Table 1. The selection criteria for determining necessary risks of the units that will be audited in the current year

No.	Risk criteria	Established	Attributed percentage
1	The level of the audits and controls performed on audited units		40%
2	Staff fluctuations at the audited system		7%
3	Time or period of auditing		3%
4	Existing of adequacy in audit departments		5%
5	the existence of human resources in the audited systems		6%
6	the existence of material resources in the audited systems		5%
7	the volume and complexity of audited systems		20%
8	The existence of professionally trained persons		5%
9	The professional involvement of the managers		6%
10	the existence of requests from audited entities for conducting audits		3%
		Total	100%

B. Realization of an algorithm for determining the audited units

Algorithm. For the 10 established criterias on unitis were attributed specific percentage.

Grades were given to each criterion(1,2,3), as follows:

Grade 1: Signifies a BIG degree of safety and control

Grade 2: Signifies a MEDIUM degree of safety and control

Grade 3: Signifies a SMALL degree of safety and control

The risks were quantified

Intervals necessary for establishing risk were set :

Interval: 1,00- 1,66= small risk

1,67-2,34= medium risk

2,35-3,00= big risk

C. Determination of big, medium and small risks for the units in the responsibility area (see table 2)

Table 2. The situation concerning the audit units based on the risk criterion on of the current year

D. Audit unit and audit systems establishment for the current year.

RISKS CRITERIA														
No.	Heard Unit		Checks Made	Staff Fluctuations	Period of Hearing	Appropriate Compartiments	Human Resources	Material Resources	Activity Volume	The Number of Hired Staff	Managers Involvement	Requests for Audit	Total Score	The Risk Determined
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10		
1	Unit 1; 5-9;		40	7	3	5	6	5	20	5	6	3	100,00	
	11-12		3	2	2	2	3	3	3	3	2	3	X	
			1,2	0,14	0,06	0,1	0,18	0,15	0,6	0,15	0,12	0,09	2,79	Big
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	Unit 2;3;4		40	7	3	5	6	5	20	5	6	3	100,00	
	24-27	Grade Ac	1	3	3	2	1	2	3	2	3	1	X	
		Cunatif.	0,4	0,21	0,09	0,01	0,06	0,1	0,6	0,1	0,18	0,03	1,87	Medium
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	Unit 10		40	7	3	5	6	5	20	5	6	3	100,00	
	13-18		1	1	2	1	1	1	3	1	1	1	X	
	20-23		0,4	0,07	0,06	0,05	0,06	0,05	0,6	0,05	0,06	0,03	1,43	Small
	27-30													
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table 3. Table concerning the audit unit and audit systems establishment for the current year

NO.	TYPES OF AUDIT	AUDITED SYSTEMS	UNIT	AUDID PERIOD		PERIOD FOR AUDIT	NUMBERS OF AUDITORS
				INTERVAL	WORKED DAYS		
0	1	2	3	4	5	6	7
1	system	personnel remuneration public acquisitions of products, services and works	county police inspectorate	----------	35	----------	4
2	system	personnel remuneration public acquisitions of products, services and works	emergency inspectorate	----------	35	----------	4
3	system	personnel remuneration public acquisitions of products, services and works	emergency inspectorate	----------	35	----------	4
4	system	personnel remuneration public acquisitions of products, services and works	border police inspectorate	----------	35	----------	4
5	system	personnel remuneration public acquisitions of products, services and works	county police inspectorate	----------	35	----------	4

6	system	personnel remuneration public acquisitions of products, services and works	emergency inspectorate	----------	35	----------	4
7	system	personnel remuneration public acquisitions of products, services and works	county gendarmerie inspectorate	----------	35	----------	4
8	system	personnel remuneration public acquisitions of products, services and works	border police inspectorate	----------	35	----------	4
9	system	personnel remuneration public acquisitions of products, services and works	county police inspectorate	----------	35	----------	4
10	system	personnel remuneration public acquisitions of products, services and works	emergency inspectorate	----------	35	----------	4
11	system	personnel remuneration public acquisitions of products, services and works	police agents school	----------	35	----------	4
12	system	personnel remuneration public acquisitions of products, services and works	county gendarmerie inspectorate	----------	35	----------	4

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INTERNALIZATION STRATEGIES FOR EXTERNAL COST IN THE TRANSPORTATION DOMAIN

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ABSTRACT

This study focuses its main idea on the external costs internalization process in the transportation activities, which is a very pressing issue for several years now in the European Union, as well as in the entire world. This issue blocks research and development in the transportation field. A substantial number of research projects, some of them supported by the European Commission, suggest the fact that applying several market strategies inspired by the theoretical economic concept for establishing the social marginal cost can bring substantial advantages to this economical branch. Defining reasonable and efficient transportation costs has always been supported by many policies adopted by the USA and the EU.

Keywords: *external costs, internalization, market strategy, development and research.*

1. INTRODUCTION

The transportation activities have certain types of impacts on the society by generating accidents, concourse and outworn on the infrastructure. The costs of these results are not always paid by the main beneficiaries from this field of activity. These so called external costs are not taken into consideration when the users decide to use the transportation facilities.

When the 1999th Directive was modified by the European Commission, regarding the taxation of heavy vehicles when using certain types of infrastructure, back in 2006, the legislator from EU requested the Commission to present a general applicable project in order to evaluate all the external costs (including those generated by non-causeway influences). This model had the purpose of being the calculus base for future taxation methods in the regard of road usage.

2. THE *"EXTERNAL COSTS"* CONCEPT IN THE FIELD OF TRANSPORTATION

2.1. The concept of external costs

The transportation domain has a significant role in the development of the global economy, allowing the existence of a global market. Unfortunately most means of transportation affect our daily society in a certain manner generating many side effects.

Motor vehicles, for example generate traffic congestion and pollution, trains and plains generate huge phonic pollution and ships damage seas and oceans. These side effects result in cost increase that can be explained in term of monetary matter, such as: the costs of delay time, health costs generated by the air pollution, productivity losses due to overcrowded traffic conditions, accidents, and high environmental costs due to climate damage by the transport activities.

In order to define external costs we need to make a clear distinction between:

- The scoial costs reflected in the total costs, due to supplies and the infrstructure usage, as well as repairs costs, capital exepenses, evioronmental costs and accidents costs;
- Private costs (or internal costs), generated straight by the users, such as usage costs, repair costs, energy costs, timpe costs.

The external costs mean the difference between social costs and the private costs. In order to produce quality values, this definition is not that precise. In the purpose of developing the economical field the main users from the transport field should cover alt the marginal costs coming from the transportation activity.

While marginal costs from a short term point of view, are relevant in the process of efficient taxation of the existing infrastructure, the marginal costs, in a long term perspective has to consider extensions infrastructure taxation. The difference between marginal costs in a short term and those in a long term depend on the way of viewing the fixed existing costs and the infrastructure variables, as well as the financing diagrams, such as taxes and commissions from the transportation domain. Thus, it is very useful to separate the infrastructure costs from taxes and contributions and other components of the external costs.

2.2. The intent of external costs

Infrastructure costs are the costs compulsory to the transport users and the society except the additional self costs.

Accident costs are all the direct and indirect costs generated after an accident (material costs, medical costs, loss of production, suffering and pain). These costs are mainly covered by the insurance companies, but they can differ from type to type.

Environmental costs are all the negative effects caused to the natural environment. These are mainly log term risks. Depending on the legislation the level of taxation and tollage for the environment differ from a mean of transportation to another (motor vehicles paying less tollage comparing to ships, trains and airplanes and other means of transport).

3. THE BEST PRACTICES IN ASSERTING THE EXTERNAL CONSTS IN TRANSPORTATION FIELD

3.1. The congestion costs

In the extended analysis it is concluded that the useful estimation of EMMC cannot be obtained using simplistic rules. The main practices to estimate the congestion costs are by using a complete approach based on the transport network and a global approach (from an economical point of view)

A network based on a balanced system gathers the most important answers form the drivers in the following circumstances: the chosen route, the destination (or the length of the trip), the way of completing it and the time of the day. This item represents the standard element of an evaluation of the transportation plan. Two main conditions have to be fulfilled in order to achieve this phenomenon. First off all reasonable ascertains between relations of the speed flow, which can be estimated as expected costs supported by the user. These flow-speed charts give us a well probability of the flow stability. Also, these charts can estimate the waiting time in the event of an traffic jam.

To calculate the EEDI will adopt a number of parameters for the main engine, auxiliary engines, innovative technology and transport parameters according to the formulas below.

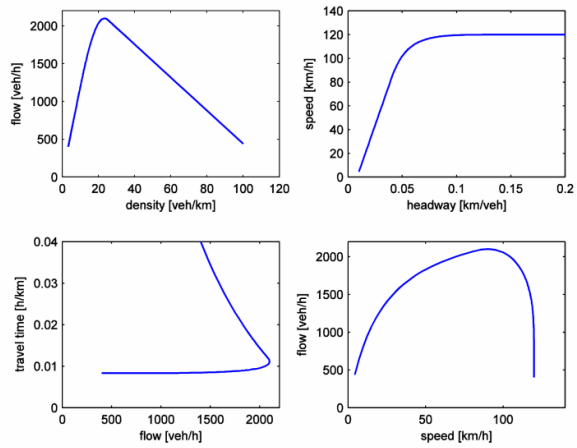

Figure 1 The fundamental diagram for the traffic flow[1]

The best option of quantifying the flow is more aggregated an it is the one used in Great Britain, based on the FORGE model, being an viable alternative for an modeling exercise on the entire network. The FORGE system defines a travelers request vector that has a quantum coordinate representing the traffic request which is differentiated in many other dimensions, such as:

- Surface;
- The region type (rural versus urban);
- The proposed journey;
- The type of vehicle;
- The type of road transited;
- The congestion lane;
- The day period.

This approach achieves the calculus of the EMCC in a iterative manner, starting in a well established reference point. This balance can represent the observed situation for a one year period. This can also be considered a decentralized balance for zero taxation, which can be modified by introducing the EMCC. Adjusting the need and the offer are being calculated using a iterative manner. It can be done by going back and forth between the cell quantities of the request and prices per travel, including the taxes equal with the external prices, as it can be observed in the following equation [1]:

$$E = \varphi f \frac{d\,t(f\,0}{df} = -\frac{1}{\varepsilon(f:\upsilon)}\frac{\varphi}{\upsilon}.$$

In this equation E represents the estimated EMCC, t is the traveling time, φ is the average time period and $\varepsilon\ (f:v)$ represents the elasticity of the flow f regarding the speed of travel.

3.2. Actual values for congestion costs

Updating the unitary values for the congestion costs are based on the conglomerate approach of the FORGE model used in the national transportation model in the United Kingdom. A useful feature of this evaluation consists in differencing a larger number of congestion traffic lanes.

The congestion traffic lanes reflect the ratio between volume and capacity from a traffic flow point of view. The volume (v) is the actual traffic flow and the capacity (c) is the theoretical maximum traffic flow. These values can be estimated in numerical values, as in motor vehicles or PCU in a certain length of time on a certain road length or lane. The next chart presents the way that traffic lane refer to ratios v / c.

Chart 1: The definition of the congestion traffic lane in the FORGE Model [1]

No.	Congestion traffic lane	Volume / Capacity
1	Free flow	v/c < 0.25
2		0.25 < v/c < 0.5
3		0. 5 < v/c < 0.75
4	In the normal values	0.75 < v/c < 1
5	Overcrowded	v/c > 0.1

More than that, the FORGE model differences several types of areas and roads. The numerical values for London are not to be considered because these results can very specific. Otherwise, these results can be applied for other large cities and are being used as typical results for other metropolitan areas.

When reporting at road types the FORGE model differences highways, type “A” roads (the main roads in the UK and the main roads with one and two traffic lanes) and other roads. The type “A” roads can be used as replacements for other road types.

An important feature of the national transportation mode system from the UK is that it includes datum regarding the traffic quota in every single congestion traffic lane on every type of road. This fact allows the execution of the average calculus traffic congestion on all the traffic lanes or on all the road types, according with the above chart. These type of datum are not available for the entire EU and, as consequence, the calculus of such an average can't be done. Taking into the account all these facts it can be assumed that in peak hours the congestion costs are at their highest values.

Information regarding the traffic actions also indicates the marginal feasibility for all costs included in the FORGE model. These estimates are based on the ratio speed / flow, which are specified for each area and type of road. These ties, speed – flow are based on the data from the national speed surveys that means that they have a high incertitude rate if the size of the study case is small, for rural areas, as an example. The noticed traffic proportion on the important roads from the rural areas with high congestion rate is very low (lower that 0,5 %).

Comparing the estimates of the marginal costs on highways and type "A" roads in the congestion lanes 4 and 5, noticing the differences between rural and urban areas, it can be observed that the values for the rural areas are higher, that being a no plausible fact. Keeping in mind the low traffic percentage in the rural areas, it is obvious that the estimates for the rural areas are not viable. Thus, the results generated by the FORGE model have to contain a correction for the rural areas. The rate of rising marginal costs for the congestion lanes on the rural area highway is being transferred from the results generated for the urban areas. For the type "A" roads the rising rate from other rural area roads is being used, in order to obtain precise results.

In order to transfer the estimates for motor vehicles to other type of cars, we have to use equivalent factors for the passenger type cars units (PCU). These factors from the FORGE model are discussed in the following chart. Hypothesis regarding the flow capacity in the model have values around 2000 PCU per lane – km for highways and a value equal with 800 – 1000 PCU per lane – km for other types of roads.

Chart 2: The equivalence factor regarding the motor vehicles included in the FORGE model [2]

No.	The type of vehicle	The PCU factor
1	Motor vehicle	1.0
2	Light transportation motor vehicles	1.0
3	Rigid HGV (heavy transportation vehicle)	1.9
4	Articulated HGV	2.9
5	Public transportation motor vehicles (buses, etc.)	2.5

Having in mid all these hypotheses, the unitary values for the congestion traffic are presented. The definitions of the area remain the same as are they used in the FORGE model and only a certain number of population is being taken into account.

Chart 3: Effective marginal costs measured in British pounds per kilometer [2]

Vehicles	Region	Type off road	Free flow (€ct/vkm)	Capacity (€ct/vkm)	Over capacity (€ct/vkm)
Vehicles	Metropolitan	Highway	0.0	26.8	61.5
		Main	0.9	141.3	181.3
		Others	2.5	159.5	242.6
	Urban	Main	0.6	48.7	75.8
		Others	2.5	139.4	230.5
	Rural	Highway	0.0	13.4	30.8
		Main	0.4	18.3	60.7
		Other	0.2	42.0	139.2
Heavy Trucks srigid	Metropolitan	Highway	0.0	50.9	116.9
		Main	1.8	268.5	344.4
		Other	4.7	303.0	460.9
	Urban	Main	1.2	92.5	144.1
		Other	4.7	264.9	438.0
	Rural	Highway	0.0	25.4	58.4
		Main	0.8	34.8	115.3
		other	0.4	79.8	264.5
Trucks articulat	Metropolitan	Highway	0.0	77.6	178.4
		Main	2.7	409.8	525.6
		Other	7.2	462.5	703.5
	Urban	Main	1.8	141.1	219.9
		Other	7.2	404.4	668.6
	Rural	Highway	0.0	38.8	89.2
		Main	1.2	53.1	176.0
		Other	0.6	121.9	403.8
Buses	Metropolitan	Highway	0.0	66.9	153.8
		Main	2.3	353.3	453.1
		Others	6.2	398.7	606.4
	Urban	Main	1.6	121.7	189.6
		Other	6.2	348.6	576.3
	Rural	Highway	0.0	33.5	76.9
		Main	1.0	45.8	151.7
		Other	0.5	105.0	348.1

The metropolitan area represents an area with a population that exceeds a population of 250000 and the urban areas have a population that exceeds 10000 inhabitants. All the other areas are considered to be rural areas.

3.3. Accident costs

The basis used for the calculus of accident costs (the main element being de fatality cost) is the estimate for static life values (SLV). These values have their origins in the evaluation studies done along. This SLV estimation differs depending on many elements, such as: country, age structure, etc., but it can also depend on different types of risks which are included in the evaluation process. The main reason consists in the fact that life expectancy can, in term of years lost can differ in many ways form case to case.

The study cases proposed by UNITE and the HEATCO study use a estimate SLV value equal with 1,5 million euro. This value is only slightly higher than the value of environmental costs, generated by the meta-analysis made by the authorities with expertise in this domain.

Keeping in mind all the elements of the accident costs HEATCO recommends a severe injury cost equal with 13% out of the fatality cost, while one light injury should be equal with 1% out the fatality cost. The economical costs, direct and indirect ones are estimated at a value equal with 10% out of SLV, depending on the rate for each country individual, according with the study published by HEATCO. This is why all the values calculated above are connected in a linear way straight to the central hypothesis, where the SLV is 1,7 million euro and can be slightly in a simple manner by scaling in the event this SLV has a different value.

Chart 4: The average costs for social accidents for European countries in 2010 (euro/vkm) [1]

Country	Fatality	Severe Lesions	Light Lesions
Austria	2,395,000	327,000	25,800
Belgium	2,178,000	330,400	21,300
Bulgaria	984,000	127,900	9,800
Croatia	1,333,000	173,300	13,300
Cyprus	1,234,000	163,100	11,900
Czech	1,446,000	194,300	14,100
Denmark	2,364,000	292,600	22,900
Estonia	1,163,000	155,800	11,200
Finland	2,213,000	294,300	22,000
France	2,070,000	289,200	21,600
Germany	2,220,000	307,100	24,800
Greece	1,518,000	198,400	15,100
Hungary	1,225,000	164,400	11,900
Ireland	2,412,000	305,600	23,300
Italy	1,916,000	246,200	18,800
Latvia	1,034,000	140,000	10,000
Lithuania	1,061,000	144,900	10,500
Luxembourg	3,323,000	517,700	31,200
Malta	2,122,000	269,500	20,100
Netherlands	2,388,000	316,400	25,500
Poland	1,168,000	156,700	11,300
Portugal	1,505,000	201,100	13,800
Romania	1,048,000	136,200	10,400
Slovakia	1,593,000	219,700	15,700
Slovenia	1,989,000	258,300	18,900
Spain	1,913,000	237,800	17,900
Sweden	2,240,000	328,700	23,500
Great Britain	2,170,000	280,300	22,200
Media în EU	**1,870,000**	**243,100**	**18,700**

As it can be observed in the above chart, Sommer's central values are based on the hypothesis that the costs for non responsible victims are not internalized. In the used methodology by MIRA in 2010 the main assumption implies the fact that a vehicle that generates a car crash is fully responsible, no matter the nature of the accident. On the urban roads the applied elasticity risk factor is the same with all the values from the estimated reports, - 0,25. For other types of roads the usage of this constant value for the elasticity factor generates higher values that the ones obtained in the Sommer evaluation, other values being equal.

3.4. The costs of the air pollution

IPA (Impact Pathway Approach) has been used in a high number of research projects and it is recognized as the most efficient tool used in the evaluation of the impact on the environment. As well as the other types of costs evaluations there can be a certain degree of misunderstanding, as well as some mathematical limitations. O good example for the quantification of the effects of emission gases and volatile particles on the human health is the level on inhaled substances on the relevant exposure manner. Even so, with the existence of so many mathematical processes, other polluting substances (such as heavy metals) can generate higher effects that are much harder to define.

The emissions generated by the transportation branch are made up out off a mix of organic and nonorganic elements, gases and particles, which may vary in size, shape, dimensions, physical and chemical characteristics. This clarifies the fact that these pollutant factors are divided in two main categories, primary pollutant agents and secondary pollutant agents. The primary pollutant agents are direct products of the incomplete fuel combustion. These agents mainly include substances as: soot, nitrogen oxides (NOx), sulphur dioxides (SO_2), carbon dioxides (CO), toxic essential organic compounds (COV), especially benzene and butadiene, some polycyclic hydrocarbons (HAP) as

well as heavy metals. The secondary pollutant agents are the ones that occur by the means of the atmospheric chemistry. The main secondary pollutant agents are the ozone on the ground level (O3), nitrates and sulphates. The ozone can be formed in atmosphere by chemical reactions that imply the occurrence of organic compounds (COV), NOx and solar light. The nitrogen and sulphites occur after burning NOx and SO_2. Certain compounds coming from the motor vehicles emissions have direct effects on the human health condition by primary emissions as well by secondary emissions (by generating secondary pollutant agents).

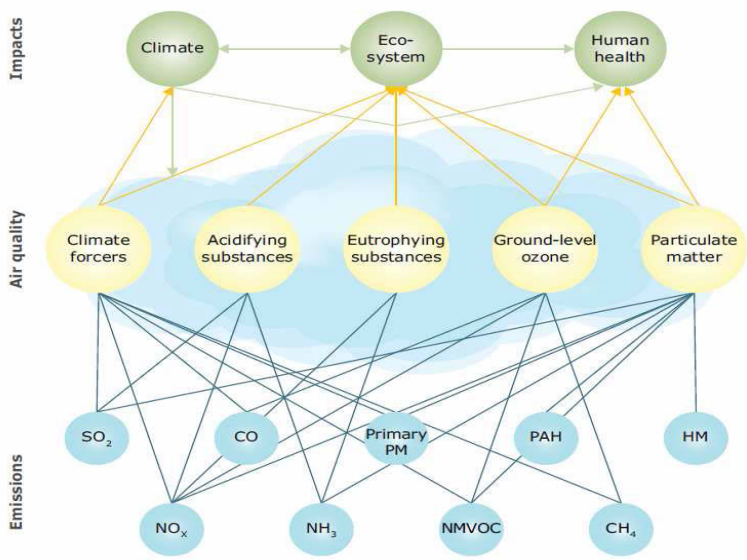

Figure 2 The main pollutant agents in the European Union [2]

Highlighting the causal effects between the concentrations of pollutant agents and their effect on human health becomes even more complex due to the high degree of complexity when we try to measure them separate, each compound individually. In fact most of the studies use mass calculations and weight measuring units for composite materials, such as PM 2,5 or PM 10. The numbers from their names suggest their size, meaning that they have less than 2,5 microns in diameter, respectively less than 10 microns. The PM compound contains primary particles generated after the process of burning fuel, which are sufficient enough to penetrate the exchange area in the alveolar surface if the human lung. The emitted particles by a motor vehicle are categorized as "smooth PM"-s. The additional emissions, the ones traffic related (around 10% of them) are generated by the braking process and the usage of tiers, as well as from the dust traffic, and they are in the PM10 category of emissions.

CAFÉ and HEATCO studies have analyzed the health damage caused by the PM pollutants and the ozone exposure. The effects on human health can include affections as: new cases of chronic bronchitis, respiratory and cardiac diseases, hospitalization, many days of confined work activity and days of low respiratory efficiency. For the most part the incidence of effects on the human health is alike in both situations/studies. Above all, the CAFÉ study separates the effects on human health in a single center which is formed by a set of functions and a high sensitivity, which is also generated by a function set, while the HEATCO study does not feature this separation. Both studies include the chronic effects and the acute health affections, which are related with the long and short term exposure at pollutant agents. That's why the chronic mortality differs from the acute mortality and this difference depends on the exposure duration.

These values are calculated for each European country and are based on medium exposure duration of the entire population from that country. The numbers don't depend on the average income from that country, because most the consequences on the human health are evaluated in average values for the EU. As a basic procedure it is suggested that the PM damage costs should be separated accordingly with the main type of inhabited areas: urban, suburban and rural. This is done mostly for financial reasons in order to calculate the real exposure level, depending on the national density of the population of that country, when evaluating local pollutants. The cost related values are presented in the next chart, for each EU country.

The gas emissions elements are calculated in accordance with the speed – emission factor, which means that the speed of the vehicle is an explicit value in the formula of the emission agents. The speed level allows the separation of the emission factors depending on the type of the road. For heavy trucks and buses differs accordingly with the type of road transited urban/suburban (35 km/h), urban roads (55 km / h) and highways (80 km/h).

For the train and aero plane transportation the most updated emission factors are included in the EMEP/EEA guides.

For the naval transportation the recent study of the European Commission generates the most relevant information regarding several emission factors, separated accordingly with different ship types.

4. CONCLUSIONS

The external costs express the difference between social costs and private costs. In order to generate quality values this definition cannot be precise. Based on the economical development theory the transportation main users have to pay all the marginal costs which are derive from this activity. Taking into account the private marginal costs (as usage costs and motor vehicles repairs and personal costs for drivers), the optimum taxes for these infrastructures should reflect the external marginal costs. These costs include the repair values and the maintenance of the infrastructure, the congestion costs, the accident costs and the environmental related costs.

Internalization can serve in many ways. According to the economical development costs the main reason of this internalization process represents a very efficient economy.

This thing is very important for the influence of the behavior of usage of certain existing resources, by offering optimum stimulants, in the neoclassical model, based on the MSCP (Marginal Social Cost Pricing). The other reasons (for an example own capitals or fiscal objectives) are known as being relevant and have been taken into account, but are not considered as being less central.

From theoretical point of view and under the rules of certain conditions the marginal social costs are a first approach, and the best one, for price efficiency in the transportation domain. The financial constraints, the high potential of implementation and cost transaction, the political arguments and interests, can block the purpose of reaching an optimum theoretical level. More than that the price structures and the optimum levels can generate less earnings in the context of economical development.

Chart 5: The average air pollution costs for the European Union (euro / tone) [2]

Country	Rural	Sub urban	Urban	NOx	VOC	SO2
Austria	37766	67839	215079	17285	2025	12659
Belgium	34788	60407	207647	10927	3228	13622
Bulgaria	34862	65635	212875	14454	756	12598
Croatia	31649	61539	208779	15149	1819	12317
Cyprus	25040	51200	198440	6465	1122	12594
Cezch Rep	43028	68427	215667	15788	1648	14112
Germany	48583	73221	220461	17039	1858	14516
Denmark	13275	40760	188000	6703	1531	7286
Estonia	15359	49948	197188	5221	1115	8441
Spain	14429	48012	195252	4964	1135	7052
Finland	8292	43997	191237	3328	781	4507
France	33303	64555	211795	13052	1695	12312
Greece	19329	50605	197845	3851	854	8210
Hungary	47205	74641	221881	19580	1569	14348
Ireland	16512	47420	194660	5688	1398	6959
Italy	24562	50121	197361	10824	1242	9875
Lithuania	23068	55535	202775	10790	1511	10945
Luxembur g	45688	71308	218548	18612	3506	15103
Latvia	19528	53638	200878	8109	1499	10000
Oland	29456	48352	195592	11574	2755	16738
Poland	47491	74215	221455	13434	1678	14435
Portugal	18371	49095	196335	1957	1048	4950
România	56405	84380	231620	22893	1796	17524
Sweden	14578	50210	197450	5247	974	5389
Slovenia	39633	67670	214910	16067	1975	12422
Slovakia	54030	79270	226510	21491	1709	17134
U K	14026	47511	194751	6576	1780	9192

Chart 6: Pollution air costs for sea regions in EU [2]

Sea region	VOC	NOx	PM2.5	SO_2
Baltic Sea	1100	4700	13800	5250
Black Sea	500	4200	22550	7950
Mediterranean Sea	750	1850	18500	6700
North Sea	2100	5950	25800	7600
North Atlantic	700	2250	5550	2900

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STRATEGIES FOR SUSTAINABLE DEVELOPMENT OF RIVER TRANSPORT IN EUROPE

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ABSTRACT

The Danube River is the longest navigable river corridor in Europe. Connects the Black Sea to the North Sea, through Channel "Rhine-Main-Danube" and reduce transportation distances from the Black Sea, through channel "Danube-Black Sea". Romania is not yet used to its maximum capacity of the Danube river transport. No multi-modal linkages created the necessary development of this type of transport. In this paper is an analysis of the current situation, strategies and prospects for the coming years.

Keywords: *Danube, infrastructure, transport, logistics, strategy.*

1. INTRODUCTION IN THE CURRENT RIVER TRANSPORT ON THE DANUBE

Danube waterway artery requires consideration of the whole interdependent, resulting from implementation of the two buildings, [1]. In support of a comprehensive and systemic approach, it aims, whenever possible, the delimitation of the balance of the action exercised by three factors: the natural environment; economic and social development in neighboring European countries; outdoor areas interconnected system.

A. Analysis of the determined action of the natural environment. This has enabled entropy assessment system recorded the Danube waterway artery, under the impact of natural factors or manifested as such, as a result of human actions on the environment, insufficiently analyzed in terms of the predictable negative consequences, [2]. This should be highlighted silting, pollution, floods, differences sensitive water levels in some parts of the river, water quality, soil erosion, advancing water damage beaches on the coast, not moving sands due to the construction of hydroelectric dams, the variation of temperatures seasons and areas, frost, etc. All these factors reduce by acting, in different proportions, the actual capacity of navigation on the Danube.

B. Socio-economic development. This is a main factor that is working to ensure the balance of the Danube complex dynamic system. Given the economic downturn, a phenomenon that occurred in Romania after 1989, this has become the restriction factor for river navigation capacity utilization. In the same category are not moving after sinking ships or armed conflict in the former Yugoslav federation in 1999.

C. The outer zones interconnected system. They represent a variety of factors whose dynamic balance is influenced by positive and negative functions of the system waterway Danube-Rhin artery. Of these the most important are:

-Danube Delta, with the objectives of tourist interest.
-Danube ports and cities.
-Infrastructure near the Danube international network of modern roads, which finance about 50% of EU funds.
-Black Sea and the Mediterranean, with important points of interference by road and rail.
-Economic activity in the Danube riparian countries, etc.

In the context of a global, systemic reflection phenomena complexity of ensuring balance of the Danube waterway artery, it was facilitated by delimiting factors in three categories presented. Steady characterization of the current state of the system as a factor reference was foreseeable advances in technology and science, particularly in the informatics and management perspective to 2020, [2].

Characterization of the economic potential of the Danube waterway, namely the legal framework regulating river navigation in terms of European integration, is an important goal today. The principles established by the Maastricht Treaty on the free movement of goods, services, people and capital, and the introduction of a single currency outlined the strategy of European integration that has been discussed in-depth in some international meetings organized on this topic, [3]. As a result of increasing interdependence between states, regional economic integration, namely the formation of the complex political stability and economic cooperation in various areas of Europe, it is a key issue that enjoys special attention.

They analyzed the elements that motivate the Danube waterway artery organization in a complex of this kind. In this framework of concerns, a key issue relates to the inherent interference of internal legal regulations of each country bordering the Danube and the provisions of international law. Any action taken by one country or another, affecting the character of the Danube waterway and freight transport and passenger capacity on the "artery should be examined in terms of the evaluation of its impact on the dynamic equilibrium of the system as a whole. Organizing a complex regional economic cooperation facilitates harmonization mentioned legislative interference.

D. Environmental protection. In the field of environment have been developed numerous regulations, but did not reach an activity consistent combating pollution and thereby Danube Black Sea. Even if the pollution was significantly reduced after 1990, still remains the "odds alarm". It notes the need for shaping

forms of regional cooperation programs of strategy, plans for the protection of the Danube basin. Through these are:

-"Environmental Programme for the Danube River Basin", concluded in Sofia in 1991, [4].

-"Environment Action Programme for Central and Eastern Europe", known as "The Danube River Protection Convention" signed in Sofia in 1994, between the Danube countries and the European Union, [5].

These are summarized in a series of short and medium-term actions. Among the goals pursued in the framework of planned actions are:

-Reduce the negative impact of the activities in the Danube basin, the Black Sea riparian ecosystems.

-Maintain and improve water quality in the Danube basin.

- Development of regional cooperation in the management of water.

Commissioning of the two-channel "Danube-Black Sea" in 1984 and "Rhine-Main-Danube" in 1992 led to the unification of the link between Rotterdam and Constanta river. This river link is strategic, geopolitical and geographical, the European Union and especially for Romania.

2. GENERAL INFORMATION OF THE "ARTERY OF THE DANUBE WATERWAY"

By making the two channels, "artery of the Danube waterway" has become an interdependent whole whose impact goes beyond the riparian countries, enrolling as a strategic factor in Europe and even the world, [2].

Figure 1 shows the artery of the Danube waterway and links between Constanta and Rotterdam. Of the 2,850 km per 1075 km through Romania and basin of 817,000 km2, Romania owns 30%. In addition Romania manages Danube-Black Sea Canal and the sea port of Constanta South-Agigea, which are crucial components of the "artery of the Danube waterway".

The direct link between Constanta and Rotterdam, are possible multimodal connections to other important areas of Europe, especially the European Regional economic cooperation with the Black Sea and the Mediterranean. But Danube is the only way to ensure access to the sea for central European countries is an important source of drinking water for consumption, agriculture and industry. They are arranged along the Danube hydropower and a series of protected natural areas, which are of particular interest for tourism, especially as the Danube Delta.

Compared to other means of transport of dry, transport costs on the river are much smaller for a number of general cargo transported in bulk, such as: oil, coal, ores, cement, wood and other products manufactured or semi-manufactured.

Carrying passengers is advantageous, as the distance traveled and under tariff issue, but it is not developed to the level required by the European Union through the European Parliament resolution relating to inland waterways, [6].

Figure 1 The Danube Artery Waterway.
Source: www.romanian-ports.ro.

Key:
-River Danube.
-Black Sea-Danube Canal and Poarta Alba-Midia Navodari Canal.
-Main Canal.
-River Rhin.

3. THE POSSIBLE FORMS OF COOPERATION

The main forms of collaboration possible in the current European context may be:

-Intermodal transport international freight European.

-Passenger and tourist cruises

-Environmental Protection rivers, inland waters and wetlands environment.

-Under international and inland waterway transport.

-Making connections with the transport infrastructure on shore.

-Infrastructure development river, inland waterway and river ports and new investment.

-Prepare joint specialists in different fields: inland waterway shipping, tourism, and operation fluvial port related services river.

-Scientific research and innovation in the field.

A. International intermodal European freight transport. International intermodal freight transport and are an important form of cooperation between the countries of Europe. This requires the development of river transport suitable hydrological conditions and existing infrastructure. In Central Europe there are more countries that have opportunities for inland shipbuilding.

Thus most construction sites river vessels: Germany, the Netherlands and Romania. In Romania are building and repair shipyards in all major river ports, such as Drobeta Turnu-Severin, Giurgiu, Oltenita, Braila, Galati, Tulcea and Sulina.

Among the EU strategies "Transportation is one of the pillars of the European integration process, closely related to creating and completing the internal market, promoting employment and growth", [7]. They were among the first areas of common policy of the EU, are considered "essential for freedoms common market ', as provided for by the “Treaty of Rome” ended in 1957, on the free movement of persons, services and goods. Drobeta Turnu-Severin, Giurgiu, Oltenita, Braila, Galati, Tulcea and Sulina.

B. Passengers Transportation. Carrying passengers on rivers and inland waters is another important form of intra-European international cooperation. In this situation, passenger vessels must comply tonnage and construction, the specific conditions of transportation "The artery of the Danube waterway", [8]. In this regard cooperation with Germany has been a priority since Germany has built and manages "Main Channel" north of the Danube waterway artery.

Romania has developed a river transport people between cities Tulcea and the Danube Delta, the three channels. It is also developed human trafficking and vehicles at crossings by ferry across the Danube.

C. Tourism and tourist cruises. Tourism and cruise tourism and inland river emerge as a priority form of cooperation. In normal operating conditions "Danube waterway artery" is one factor propelling the entire tourism activities in Romania, [2]. Given Romania's possibilities to provide all required forms of tourism, "the Danube waterway artery" will facilitate attracting foreign tourists to sightseeing in various areas of the country such as Delta and other sights nearby Danube. These sights can benefit from the work of this river navigation.

The position they occupy Romania can even be a true "hub" of tourism between three continents: Europe, Africa, and Asia. Full integration in the European Union opens great prospects for the development of international and domestic tourism on the river, especially in the Danube Delta. This requires above all the transport ships are built, are adapted to the specific conditions of passenger transport on the Danube. Tourism and cruise tourism should be linked with the transport infrastructure on shore and sights from inside. Regarding the safety of passenger ships, the European Commission has set three main objectives as follows, [9]:

-To ensure continuous improvement of existing legislation to protect passengers with a greater emphasis placed on defining global rules at the International Maritime Organization (IMO).

-Respect safety rules to ensure the correct application of EU legal instruments and IMO.

-Encourage industry to act voluntarily waterborne towards constant improvement of naval operations.

D. For environmental protection of rivers, inland wetlands and the environment. Environmental protection represents an important way of attracting cooperation between the peoples of Europe, in the European Union and beyond. From partial agreements concluded by Romania with one or other of the countries bordering the Danube, will require a legal approach to such issues as a prerequisite for the proper functioning of these arteries river, [2].

The European Union is party to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, after its approval in 1995. The Convention created a framework for bilateral or multilateral cooperation to prevent and control pollution of transboundary watercourses and ensuring uses rational use of water resources in the member countries of the Economic Commission for Europe of the United Nations, [10].

At the meeting in 2003 of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, the Parties to the Convention have expressed their willingness to allow States situated outside the UNECE region to become Parties to the Convention in order to promote cooperation within river basins around the world, [11].

Other UNECE environmental conventions, um is the Convention on Access to Justice in Environmental Matters, [12] and the Convention on Environmental Impact Assessment in a Transboundary Context, [13]. All these are open to the Member situated outside the UNECE region.

E. International legislation transport and inland waterways. The legal regime of movement of goods and people is another important area, possible cooperation, [3]. For this analysis should be conducted of the current regulatory provisions, to correct and supplement them to ensure adequate freedom of movement. The general principles of cooperation between states must be specified by decision makers from the European economic body, which must take into account the domestic law of each partner country.

Hence the need for harmonization between national legal regulations and international maritime law, [14]. Competitive conditions in the market economy, the countries bordering the tariffs for services must reflect the requirements of a competitive, compared to other means of transport, as it is regulated in each country by the competent authorities, [15].

F. Making connections with the transport infrastructure on shore. The development of the Danube waterway artery, without taking into account the infrastructure of the land can't result in significant results. Connections must be assessed in real economic context, the needs of transport options for freight owners and carriers to dry. The vast majority of river ports are connected to European roads and highways, especially in Central European countries.

But the situation is different in Eastern Europe, particularly in Serbia, Bulgaria, Romania, Moldova and Ukraine, countries bordering the Danube basin. Have connections with major ports and railways, but in some ports required new investments in order to achieve river ferry lines sites.

G. Development of infrastructure and new investments. To make a real transfer of freight from roads to inland are a number of large investment required for these connections to make cost-effective transfer of freight from land to inland waters. As appreciates the special report of the Court of Auditors, presented in early 2015 on the inland waterway from Europe in 2001, did not have significant improvements in transport multi-modal and improve conditions for inland navigation, [16].

Given the "Artery of the Danube Waterway" in the coming period further action can be initiated cooperation between riparian countries to materialize and developing the necessary infrastructure and various commercial and tourist circuits of interest. Sectoral Operational Programme "Transport" 2007-2013 (SOP-T), the European Union has created a strategic instrument for the development of the transport sector in member

countries, to modernize and develop priority axes "TEN-T", the measures needed environmental protection, modernization and development of national transport networks, in accordance with the principles of sustainable development, promotion of rail, waterborne and intermodal transport, [17].

It also aimed to support sustainable transport development by minimizing adverse effects of transport on the environment and improving traffic safety and human health.

H. Training of specialists. Each artery waterway riparian country has a number of institutions and organizations responsible for training and retraining of seafarers river of Personality auxiliary port workers in related fields or river transport.

Operational Programme Human Resources Development (OPH RD) between 2007-2013 was made available to all entities, public or private, large sums of money that could be used for training and improvement of waterways and auxiliary crews, [18].

I. Developing research. The European Union will put more emphasis on scientific research, innovation and investment in research so that countries develop sustainable, reduce oil dependency and to prepare EU industry to face current challenges.

Through the "Connecting citizens and businesses in Europe, the Europe 2020 Strategy for Growth in Europe", [19].

The "Horizon 2020" brings together all funding for research and innovation in one integrated program, with a series of objectives as follows:

-To Strengthen the European Union's position in science.

-To Strengthen industrial innovation, including investment in "key technologies" and support improved access to capital for small businesses.

-To Address key challenges such as climate change, sustainable transport, renewable energy, food security and safety and aging.

The "Horizon 2020" aims to ensure that technological advances are translated into viable products with real potential for commercialization by linking providers of public resources and private enterprises; to intensify international cooperation in research and innovation by stimulating the participation of organizations and countries outside the European Union; further developing the European Research Area.

In the chapter "The future of EU transport policy", the same program are provided a number of issues that should guide scientific research for transport smart, green and integrated. Also, through the "Horizon 2020" are to achieve a sustainable transport system, suitable for a modern and competitive Europe.

4. ROMANIAN REGIONAL ECONOMIC COOPERATION COMPLEXES, KEY COMPONENTS OF THE STRATEGY OF EUROPEAN INTEGRATION

Free movement of persons, goods, services and capital established by the Maastricht Treaty were discussed and improved international meetings that followed, [20]. In all cases the organization of regional economic cooperation has enjoyed special attention, but this guidance does not reflect a short term phenomenon, but lengthy. In a multipolar economy, the formation of regional economic cooperation organizations is "the most suitable solution for solving the impact of the sharp rise interdependence of national economies".

Formulation European regional economic cooperation body "Artery of the Danube Waterway" meets the requirements of European integration strategy. Romania is "a factor of cooperation and security in the center of Europe." In this respect, Romania can take a number of economic projects, infrastructure for inland waterways and inland thus, Figure 2:

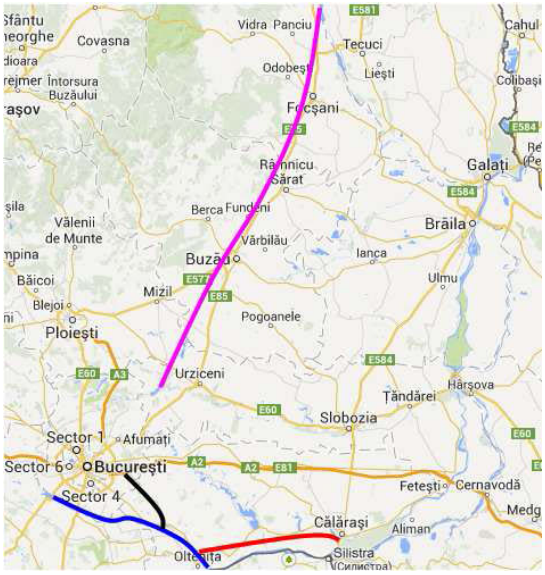

Figure 2 Projects inland water channels.
Source: author study of the Ministry of Transport documents.

Key:
-Bucharest-Danube Canal, complex construction of Arges river.
-Bucharest-Danube Canal, complex construction of Dambovita river.
-Oltenita-Calarasi Canal.
-Siret-Baragan Canal.

- Completion of Bucharest-Danube Canal, Figure 3, which will link Bucharest to other European capitals, located along the Danube, i.e. Belgrade, Budapest, Bratislava and Vienna, and the port of Constanta and the Danube Delta, [21].

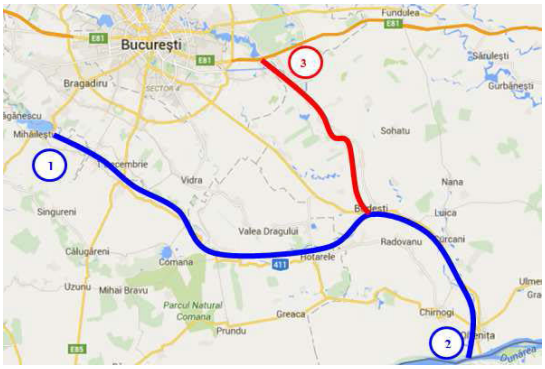

Figure 3 Bucharest-Danube Canal.
Source: Ministry of Transport study author of the documents.

Key:
1 = Port of 1 December.
2 = Port of Oltenita.
3 = Port of Glina.
-Bucharest-Danube Canal, complex construction of Arges river.
-Bucharest-Danube Canal, complex construction of Dambovita river.

-In parallel with the Danube, seeking the construction of a canal between Oltenita and Calarasi, Figure 4, [22]. This Act is designed to leave the canal linking Borcea, located west of Lake Calarasi Municipality, built steel mill which was closed and the channel Bucharest-Danube, north of Oltenita.

Channel could take over traffic on the Danube, when the water level is low, would also be used for irrigation and fish farming.

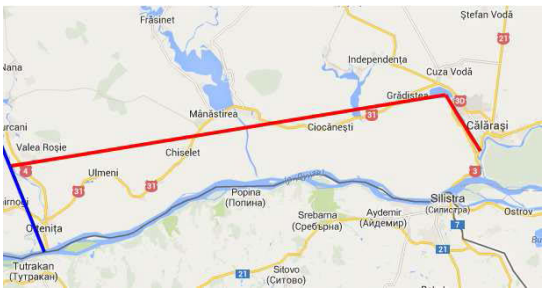

Figure 4 Channel Calarasi Oltenita.
Source: author's study, Calarasi County Council processing the documents.

Key:
-Danube river.
-Bucharest-Danube Canal.
-Oltenita-Calarasi Canal.

-The Canal Siret-Baragan was designed to link the Siret River with Lake Dridu near Urziceni, from the plains of Baragan, Figure 5, [21].

This channel is designed to pass through a 186 km distance, having to take on the role of the transport of goods from Adjud up to Urziceni and for irrigations. Also this channel has great potential for tourism and fisheries. All these investments can be integrated into European cargo supply circuits; can help reduce pollution and road congestion.

5. CONCLUSIONS

For full European integration Romania will occur when all economic, social and political will be integrated. About a sequential integration can't question. Therefore factors driving interest in transport should be oriented towards what can integrate easily with low cost or obtained grants from the EU budget. If urgent measures are not taken and solutions found, it is likely to lag behind in all areas, and among the most visible aspects of the lag will be transported.

The usability and development of the Danube waterway artery is very high, given the lags even Europe-wide.

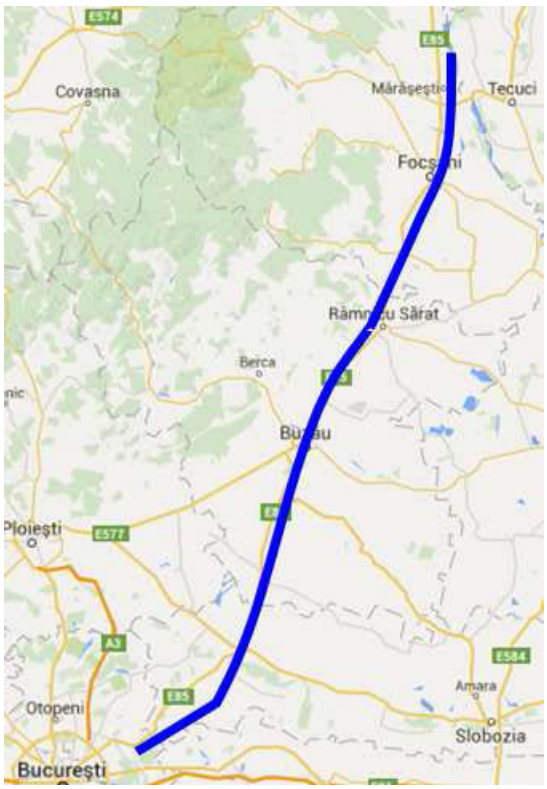

Figure 5 The Siret-Baragan.
Source: Ministry of Transport study author of the documents.

That can make projects and access funds for river transport for the modernization of ports and port infrastructure, to complete the Danube-Bucharest canal and other two projects begin and end channels. Institutions that are able to become directly involved in accessing these funds and start projects by the Ministry of Transport companies are subordinated to National Company "Maritime Ports Administration" SA Constanta National Company "River Danube Ports Administration" SA Giurgiu National Company "Maritime Danube Ports Administration" SA Galati National Company "Maritime Ports Administration" SA Constanta. And through a public-private partnership can be attracted and port operating companies from all Romanian river ports.

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COMPUTER SYSTEMS TECHNOLOGIES USED IN TOURISM ACTIVITIES

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ABSTRACT

The second half of the XXth century was marked by the increasing penetration of striking and active management of information systems in business and tourism companies. This trend was justified by the possibility of extending the information system through computer systems.In this paper is made a brief overview of the most common systems used in tourism activities.

Keywords: *global distribution systems (GDS), computer reservation system (CRS), booking, reservation system, accommodation.*

1. INTRODUCTION

Most countries in the world are involved and engaged in tourism industry, which attracts both local and international visitors. [1]. Technology-driven change is revolutionizing every industry, including tourism, from retail distribution to banking, from manufacturing to publishing and education. The pressure of new technologies (computer, networks, interactive television) combined with increasing customer demands (flexibility, convenience, customization, service, etc.) and hyper-competition (global markets, shrinking product cycles, increasing risk, rapid change) is requiring companies to redefine their strategies, products and processes [2].

It is well known that between the computer systems and the information systems there is a report as from part to whole. Computer systems comprise both manual and automated / mechanized phases of collecting and recording information, handling information and processing information.

Currently is seen an increase in the share and role of the computer system within the information system as a whole. Although in large organizations, especially in the services sector and especially in the tourism sector, the computer system gathers over 90% of all elements of information, we must recognize that there will always be elements of information - those related strictly to human nature - with a strong informal character, that will not be part of the computer system. Large tour operator companies, specialized in international transport of passengers, especially those in tourist transport, introduced the use of specific information systems to certain specific activities of their activities. Proving particularly dynamics, the field proposed numerous other applications in the hospitality industry, restoration and, not ultimately, for animation and recreation. The known success of tourism activities computerization is undeniable, and today the development of efficient systems without their use of is unthinkable.

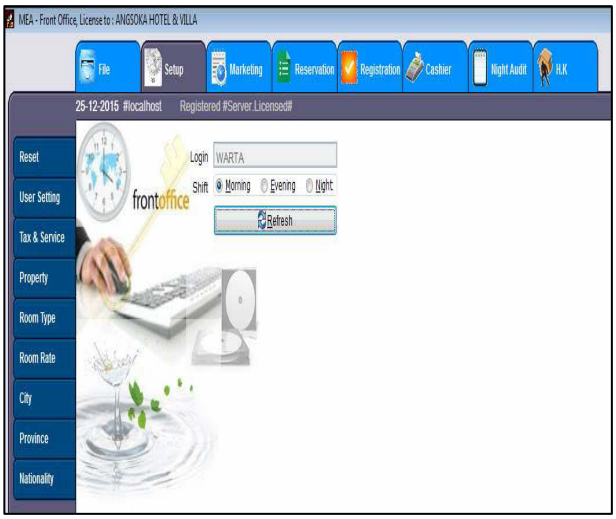
According to Shafiee, S. and Shafiee, H (2014), Information and Communication Technology (ICT) and tourism are two cases of global dynamic stimuli of an emerging economy. World Tourism Organization (UNWTO) defines the electronic tourism word as: the word "Electronic Tourism" means applying electronic business in trip and tourism. Electronic tourism means digitalization of all processes and value chains in tourism, travel, hospitality, and leisure. The considerable point in this word is that the electronic tourism does not mean travel or trip electronically [3].

2. FRONT OFFICE COMPUTER SYSTEMS

Front office computer systems are information processing systems providing reports in visual or written form. They are used mainly in management activities of accommodation facilities, medium-sized and large (used for land transport- diversified accommodation equipment: hotels, motels, hostels etc. or for shipping tourism - cruise ships), as well as in travel agencies.

Figure 1 Front Office System. Source: [4]

These systems may be:



- Tourist registration systems - systems that take over personal data of tourists;
- Tourism products marketing systems – for a diversity of touristic services, e.g. car rental etc.;
- Chambers' management systems - systems which provide information on the occupancy of rooms, rooms status (occupied / available,

cleaning etc.), financial situation, messages retrieving and various statistical information;

- Systems for tracking revenues - which provides processing of transactions and information about debits and credits of customers.

Such Front Office systems are used also in Romania, successfully, frequently, especially after 1990. The development of such applications has made progress related to the size of serviced units (number of rooms), the number and diversity of managed tourism services, forms of payment etc.

3. COMPUTER SYSTEMS USED FOR RESERVATIONS

Computer systems used for reservations are systems that can operate with both individual tourists and with travel agencies or commissioners. These systems are characterized by the fact that they gather services of information, booking and sale. They provide quick and accurate access to information, allowing an optimal selection and the best offers.

It is well to know that besides classical booking systems of (organized as their personalized systems of large groups /hotel chains - CRS or global distribution systems - GDS) today there is an increase of Internet based reservation systems (used by companies that run transnational operations, but not only).

As known, the Internet has revolutionized the dissemination of information - virtually abolishing geographical boundaries. In the opinion of M.P. Feldman (2002), "the Internet provides tools that allow individuals to access information easily and certainly aids innovative activity yet factors such as the tacit nature of knowledge and the social nature of the innovation process limit the impact of the Internet" [5]. Statistics of the International Telecommunication Union (ITU) show that in 2005 there were 1.024 million individuals in the world using the Internet, while in 2015 the figures expanded to 3.174 millions [6].

The Internet had a timid entry in Romania, in the year 1993, but its evolution has been particularly fast, especially in education, communication and not ultimately in tourism services. The last years of the last century and the early years of the present one, have seen an increasing number of websites on the Internet for each domain: flights, hotels, rent-a-car companies, trips and travels, which can be booked directly without consulting a travel agent, e.g.: Travelocity (www.travelocity.com), Travelweb (www.travelweb.com), Expedia (www.expedia.com), Vizion (www.vizion.com),

Yahoo!(www.yahoo.co.uk/business and Economy / Companies / Travel). For example, Expedia is supported by Microsoft and has links to agents as Amadeus, Travelport, which provides: plane tickets, reservation of hotel rooms, rental cars, train tickets, lump trips, etc.

The Internet, "through its addressability, can transform the prominent marketing communication paradigm from one-to-many to one-to-one or from broadcasting to narrowcasting. The traditional media, such as print, radio and television, follow a passive one-to-many communication model, whereby a company reaches many current and potential customers through the broadcasting of the same message" [7].

According to the technological evolution, today the three major phases of marketing the tourism product on Internet8 are:

1. New media and systems generate strategies that emphasize globalization and deregulation of tourism markets, more strikingly on the air transport.

2. Electronic reservation and distribution are essential components of marketing strategies in air transport. They transmit and process information more effectively than any traditional system used by individual companies.

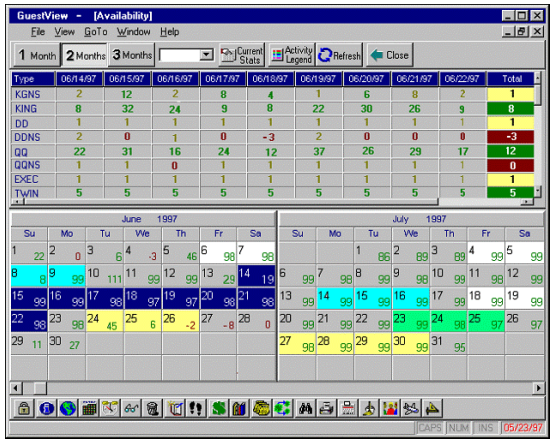


Figure 2 Electronic reservation interface

3. Each company has its own CRS (computer reservation system). They can be connected to a GDS (global distribution system) which is a network used by travel agents to find information about all airlines and service providers registered in the system.

International reservation and distribution systems play a decisive role in international tourism since they put in contact providers and buyers of tourism products. Especially tourism companies from North America and Europe use GDS sites. A per cent of 2/3 of agencies connected to GDS are located in the North America or Europe.

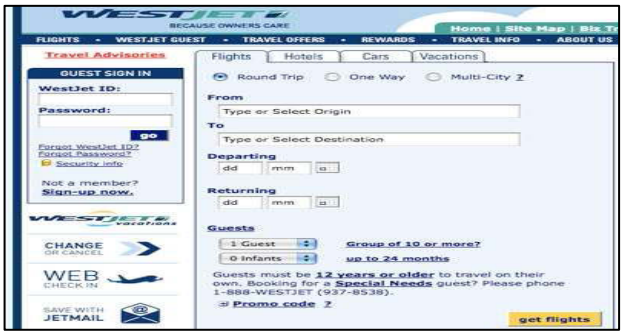


Figure 3 Computerized reservation system. Source:[6]

Global systems processes information and reservations more effective than single-access type systems. However, the strategic importance of GDS declined since European and the US authorities have introduced clear rules to prevent getting unfair

advantages by distorting the information provided by various operators, such that could obtain higher incomes than when they hold themselves a GDS.

We can find the same tendency of specialization or market dependence regarding a particular system on specific countries. The most used international booking systems are: -Amadeus mainly in: France, Germany, Scandinavia and Spain, Galileo especially preferred by countries such as Austria, Ireland, Italy, Portugal, the Netherlands, Switzerland and the UK. In 1990-1991, negotiations were initiated in connection with the formation of a market alliance between Sabre and Amadeus by taking in the first system a part of the other system.

CRS (computer reservation systems) market structure is in constant evolution, with significant scope to become more oligopolistic than even air transport market. Moreover, integration and concentration of the CRS has accelerated the trend of integrating airlines. Most hotel chains have their own booking offices, or are linked to an international system. Rail shipments have also initiated, a reservation system: SOCRATES - Systeme offre la Clientele at Reservation d'Affaires et de Tourisme en Europe - in connection with Sabre10 that provide services for travel and accommodation.

Reservation and information systems are of three types:

1. Information systems, which operates as databases available through transmission systems - Minitel - for consultation. Customer may request and receive detailed written information.

2. Availability systems, which provides information on open or fully booked status of a hotel at one time. Such systems are considering unanticipated customer arrivals in a city. In strategic places (airport, railway station, city center) are placed electronic panels including city plan, with locations of hotels adhering to the system and their characteristics (category, charges). For each hotel, on the electronic panel the status of the available rooms are indicated with green light and full booking with red light. Viewing the up to date information on the panel is remote controlled right from the hotel respectively. After consulting the panel, fully informed, the client can make a booking, either by telephone or by pushing a button that makes the connection with the hotel. Each hotel adhering to such a system pays an annual fee.

3. Computerized reservation systems are similar to inventory management systems, in regard of the situation of rooms or seats available or already booked (reserved). Also in the system can be designed simpler solutions. In the airport or train station telephones may be placed to put the customer in touch with the hotel by simply lifting the handset (system used by Novotel).

An airline's computerized reservation system (CRS) is a typical computer assisted sale system. There are three categories of personnel in a CRS business environment: vendors who provide the services, agents who act as representatives for the vendors, and customers/shoppers. CRS is used to facilitate the sale process[1].

The characteristics of a CRS are:

1) CRSs are usually very large and complex; large host complex, wide-spread and heterogeneous networks, large numbers of terminals including personal computers, printers, and other terminal devices.

2) It demands high performance, high throughput because of its on-line real-time requirements and large volume of transactions.

3) It is mission critical because business is relying on the system.

A computerized reservation system encompasses three tiers of functional components:

reservation/information services, communication networks, and agent/customer premise applications.

Reservation systems of major international hotel chains are: Holidex - Holiday Inn, Roomfinder - Ramada, Marsha - Marriott. Besides specialized reservation systems, property of large groups and hotel chains, there were made reservation systems that function as independent companies and contract with hotels interested in such systems. Often the founders of a system of this type are more independent chains, smaller sized or major hotels. Once established, such system will prove to be interesting for all categories of hotels: big and small, individual holdings, hotels chains, seasonal or permanent hotels.

The main functions provided are similar to specialized booking systems: informing the tourist about the hotel and accommodation, as well as taking reservation requests. Some companies, besides booking activity, and thus brokerage sales, assume and communication activity performed in the interest of the hotel on certain markets. This reflects the nature of representation companies. The role of representation companies is major in the case of hotels located at long distances from their customers (US hotels compared to Europe clientele).

The largest hotel representation company was until recently Utell International (UK), created in 1975. In 1997, from the association between Utell Intl. and Anasazi Travel Resources Inc. resulted REZsolutions with 1.5 million rooms in 700 hotels, located in USA.

The newest trends show that in European and US airline industry, the development of internet based e-commerce models effectively reduced both airline's and hotels reliance upon CRS vendors and traditional travel agencies. Newly emergent air ticket distribution models gave airlines in particular and for tourism industry in general, more choices to distribute their tickets, also it bought great pressures upon CRS vendors and traditional brick-and-mortar travel agencies. From experiences of US and European markets, new internet based e-commerce models have effectively lowered airline's air ticket distribution costs. Also those models gave airlines more controlling power over the air ticket distribution process. Similar to CRS model's development since late 1960s, it might be true that internet based e-commerce

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air ticket model would become the predominant model in the future [9].

4 CONCLUSIONS

Internet technologies have a huge contribution for shaping today's tourism industry. Current trends vary from front office systems, computer systems used for reservations, global distribution systems and e-tourism. They all have the purpose to automate collecting and recording information, handling information and processing information. No matter the system used, they all have the advantage of speeding up the economic processes within the tourism industry while providing a more efficient management.

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PERFORMANCE IN THE RIVER-SEA SHIPPING

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ABSTRACT

The shipping river-sea services are an essential part of the shipping industry and serve the direct exchange of international industrial or agricultural products and goods, which are guided by interests and industries concerned, namely agriculture, can be affected by a number of processes qualify as freight flows architectures having different effects in different sections.

Keywords: *performance, shipping, strategy.*

1. INTRODUCTION

This paper addresses the naval transports, with economic performance and competitive advantage applications as part of international relations particularly important.

According to the literature, the term "international relations" refers to the totality of political, economic, cultural, social, legal, diplomatic, etc. between states, governed by legal acts, principles and/or rules of international law. In the present research aims to highlight links two- way of international economic relations (and the related legal and political) and international shipping of goods. A definition of international economic relations meant by this set of economic relationships covering: trade, services, relations in the sphere of production and scientific research, financial relations and credit, as well as any other operations by which the world values circuit .

The study of performance in shipping is configured on the research of entire world and European shipbuilding industry, being conjunction with market analysis and economic outlook, i.e. port infrastructure in areas where marine transportation occur. The shipping industry is governed by laws, rules and regulations aimed at both transport legality and safety of navigation and environmental protection. Environmental protection was confirmed to be the challenge of leading the trend in the today marine industry and the strategic planning process of "end to end" include links between corporate mission of the shipping industry organizations and how their vision is translated into practice.

2. METODOLOGY

The research methodology used in the making of this article is considered a qualitative research that follows and confirms the hypothesis of technical and economic performance with positive environmental impact of a river shipping companies where technology is used in the context of current economic performance clean.

Theoretical foundations of organization and performance in marine transport are summarized in the fundamental workings of Romanian and foreign authors (Hans J. Peters, Athanasios A. Pallis, James J. Corbett, James Winebrake, Serescu Mihai, Gheorghe Caraiani, Catalin Popa).

In the marine industry are known two types of architectures of the shipping companies i.e. companies whose assets (ships) are dedicated economy statist and companies that are present in competitive transport market (for therd), which shows many facets that interact with the environment politico-economy and support that needed flexibility to synchronization with the dynamic needs of the market.

Considering the general economic progress of society, in the last decade it was recorded unprecedented growth in global trade, of basic raw materials transport, needed by industry, agriculture and trade of manufactured products. On the other hand, increased trade between countries in different geographic areas, along with their participation in international flows of goods is a prerequisite for boosting economic and social progress of each region separately.

River-sea services shipping are an essential part of the shipping industry and serve the international direct exchange of industrial or agricultural goods products, which are guided by interests and characteristics of industries, namely agriculture, can be qualified by a number of processes qualify as freight flows into different architectures having effects in different sections.

Pictures 1: European course of the Danube
Source:https://www.google.ro/search?q=harta+dunarii&espv=2&biw=1600&bih=799&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwi_8onyyJHNAhXCVxQKHd3wAJcQsAQIJQ#imgrc=HVoOYjQ_rdSL0M%3A

European policy of greening and environmental protection, including marine environment, imposes regulations adopted in the terms and conditions quite generous reactivation shipping "inland" and sea because it is the least polluting per unit of freight transported, compared to car or rail. Regulation imposes rules to reducing of pollution close to "0" using gas propulsion, thus relaunching the shipping industry by supporting technological innovation, resizing shipyard activities with major effects on safety and quality shipping service. Internationally, in naval transport, crisis has had destructive effects immeasurable, the shock transforming its naval fleet structure itself. With the establishment of economic recession resulted in decreased trade and thus the amount of goods transported by sea, depending on geographic area or economic, resources of each economy or the policies promoted, held a timid attempt to optimize naval transport by owners who wanted to remain on the market. Goods able to be shipped imposed types of ships and their ability was dictated by the needs and consumptions each zone. Over time it turned out that the demands from customers have been polarized into three main areas, namely: the very big, whose cost per unit of measure are very small, vessels which have capacities relatively small but support political parties reduced imports or exports in goods, or intermodal transport. This one has registered lately a major revival, being used for goods of all categories, with the possibility of plots merchandise and having the support the regularity with which it is performed.

Romanian shipping has gone through major transformations with the current geo-political and economic situation. The evolution of these phenomena printed tracts whose sudden changes have challenged the managerial capacity of leaders of shipping companies, which, with better or worse results they tried to cope with adverse situations they faced in the last 20 years. The complex of negative factors that affected the early 90s of last century Romanian fleet belonging to the state, were declining situation of the European economy and partner countries of Romania, until then - CAER. To this disastrous situation was added the Romanian industry too, that had to enter into a transition period and privatization. Of course, because of development activity shipping, this situation was not very comfortable, especially because Romania's fleet was aging and designed to serve the Romanian industry with relatively high costs. Soon, the Black Sea was isolated from a commercial perspective, while all countries bordering, with the beginning of the 1996 armed conflict from the ex-Yugoslavian territory. This conflict led to blocking navigation on the Danube River with the establishment of the embargo on Yugoslavia. Such was the largest sectioned cargo transport channel between Western Europe and Eastern Europe. Both Romanian navy and the river have suffered economic losses due to the inability to achieve or limitation of transport in terms of effectiveness. Last and most important attempt of navigation companies was felt of all shipping companies too, once the economic crisis, starting from 2008 - 2009, namely the commencement of armed conflicts in Arab countries in North Africa and eastern Great Mediterranean. These important sales markets for Romanians owners were not accessible due to these conflicting. Commercial potential has decreased dramatically, reaching the lowest levels in recent years. Shipping companies have a policy of forced survival, relying on the experiences of previous years. Of course the crisis were felt strongly by the company, but the owner was striving to maintain and increase deliveries promptness largely service quality. Company management also sought to implement or retain greater flexibility, optimizing transport features both Mediterranean Sea, Black Sea and the Danube River. Situation of crisis and economic recession have not spared even the Northern European shipping companies. They have recorded heavy periods, but they had abilities to maintain on the market bringing new concepts of modernization and optimization of shipping. The crisis and its effects on international shipping activity were studied by Hans J. Peters in "The Maritime Transport Crisis" under the tutelage of The International Bank for Reconstruction and Development / THE WORLD BANK 1818 H Street, N.W. Washington, D.C. 20433, U.S.A.

3. RESEARCH RESULTS

The economic crisis mainland and conflicts which involve countries bordering the Black Sea (Ukraine, Crimea) and those, whose fragile political situations or in conflict, bordering on the Mediterranean (Syria, Libya, Egypt), are contexts totally unproductive for shipping. We appreciate that their end is somewhat imminent, and commercial transport potential of these zones is and remains very high. As soon aspossible, consider that will go to the reconstruction and economic recovery of these areas, which will create new transportation outlets and outlets for coastal shipping companies. Moreover, commercial spirit will certainly contribute to the revival of commercial activity above mentioned basins, and increasing trade with them, will help to increase the activity of shipping goods.

Although seriously affected the activity of shipping the last five years was held at subsistence, small companies managed by flexibility to survive registering but profit ridiculous and making efforts to reduce costs and specially to avoid or eliminate as much as possible losses. These measures were also supported by a decrease of employees' salaries, in conjunction with the reconfiguration crews and reorganization of the company structure. Quality of transport remained unaffected despite these efforts visible beneficiaries of transport services. The company's most important competitive advantages - speed, reliability and timeliness of operation for all beneficiaries remained unchanged, the company managed to position itself appropriately among competitors and contribute greatly to reposition Romanian shipping industry.

In the current political and economic conditions, shipping goes through fundamental revolution by point of view of technical and legal, especially as regards the protection of the marine environment, eliminating pollution. This highlights a major impact on shipping companies whose economic strategies and/or processing markets are reformulated in order to obtain a stable place

on the market, namely the increase of indicators regarding of efficiency and performance. Therefore, the present research is considering the activity support of lower shipping companies that aimed performance by implementing advanced technologies and repositioning in the market of a naval carriers by creating viable strategy business and redesigning the entire ensemble that supporting active technology assimilated, pursuing business efficiency in terms economically in terms of increasing the quality of provided service, to ensure navigation safety and marine environment protection.

4. CONCLUSIONS

The author of this article aims to research and confirm the hypothesis efficiency clean technology deployment in river fleet in order to achieve economic performance through quality transport service, competitive advantage while eliminating polluting factors.

Due to technological evolution, at the same time with the alarming evolution of a global warming, occurred legislative environmental taxation too. They have a major impact on shipping companies which, in future given, are obliged to renew its fleet with clean ship, to retrofitted assets owned, or pay taxes and countless prohibitions which lead to activity restriction and the company's elimination from the shipping market.

International shipping, on current economic context and legislative, outlines a series of reconfigurations with implementation since 2016 of a clean technologies (propulsion that has as fuel LPG, LNG), whose effect is felt both within companies for navigation, where new strategies are required to obtain performance management, and the horizontal adjacent shipping industry that delivers and supports technology or personnel in the marine industry, while imposing increasing the quality of transport services.

On the basis of technical and economic performance of transport is the latest technology (gas-powered) which is required by current legislation in all areas of transportation. This technology is preferred because it contributes significantly to reduced transport costs, reduce pollution, while increasing the quality of transport in conditions of maximum security. Seafarers and naval auxiliary from naval industry must adapt to these legislative specificities, progressing professionally in all these technology changes.

In the current paradigm that is required with the restructuring of both the concepts of quality of service, along with environmental protection in competition with economic performance, technical factor is the motivation to achieve the economic goals of a small size company shipping that, sensitive to external factors, is forced to reconfigure the strategic and organizational point of view, in order to manage the change, prioritizing actions that support upgrading vectors while repositioning the company in the market.

Although shipping is a practical activity, but unpredictable for long periods, in theory naval transports are found amounts of paradigm, that, in evolutionary perspective practice, could not be applied. Most studies are wrong based only on economic developments, ignoring the evolution of technical and technology or implementing environmental measures in an effervescent industry, where innovation both technical and economic, is the base of performance.

Navigation Company is the entity that feels all political and economic vibrations that influence positively or negatively international trade whose goal is shipping. Study and analyze of these forces, whose resultant affects shipping stability, can be found in The Greek Paradigm of Maritime Transport: A View From Within Athanasios A. Pallis and The Impacts of Globalisation on International Maritime Transport Activity by James J. Corbett and James Winebrake .

Previous research (maritime- transport liberalization Benjamin Parameswaran (2004) ISBN 978-3-540-22240-8; Matitime Transport and destabilizing Grifiths Commodity Flows Hugh and Michael Jenks, Maritime transport The Greek Paradigm Alexandros Pallis) had in mind always fluctuations in international economic that affected the activity of shipping that in five years, which was held at subsistence, small companies managed by flexibility to survive, registering but profit ridiculous and making efforts to reduce costs and especially to avoid or eliminating possible losses. These measures were also supported by a narrowing of employees' salaries., in conjunction with the reconfiguration crews and reorganization of the company structure. Quality of transport remained unaffected despite these efforts visible beneficiaries of transport services. The company's most important competitive advantages - speed, reliability and timeliness of operation for all beneficiaries remained unchanged, the company managed to position itself appropriately among competitors and contribute greatly to reposition Romanian shipping industry.

In the current political and economic conditions, shipping goes through fundamental revolution in terms of technical and legal, especially as regards the protection of the marine environment, eliminating pollution. This highlights a major impact on shipping companies whose economic strategies and/or processing markets reformulated in order to obtain a stable place on the market, namely the increase of indicators in terms of efficiency and performance. Therefore the present research is to support the activity of small shipping companies, aimed performance by implementing advanced technologies and repositioning in the market of a naval carriers by creating viable strategy business and redesigning the entire ensemble supporting active technology, equated pursuing activity efficiency in terms economically, in terms of increasing the quality of provided services, to ensure navigation safety and marine environment protection.

Research on Environmental politico-economic, technical and competitive in the naval field in the current economic context, establishes methods of markets approach in the study, namely the Black Sea, Mediterranean Sea and North Sea with ships of appropriate capacity and technology fit to meet the needs of transport, while ensuring superior quality offered by fast transport, safety and environmental protection.

If exercise is quite different research has been focused on political and economic turbulence or concept

(e.g. intermodal transport), there are theoretical economic studies and applications, at the moment it materializes a new revolution in technique and structure of naval transport. This revolution is dictated by legislative antipollution rules that oblige shipping companies to use advanced technologies and clean. Thorough research both factors politico-economic and the evolution technical propulsion lead to a pertinent analysis, underlying strategy of transition to a shipping company considered small, that implement clean technology appealing to own resources, organizing and planning work so that transfer of technology was not destabilize the economic situation and even more, to current to higher economic performance. Because the technology is in service for a little while, and studies and comparisons in terms of technical and economic are considered strategies, they are not public, being kept and used by shipping companies, in order to correct or design of complex naval performing chasing competitive advantage.

The small number of these published studies lead to the need for research, new propulsion systems along with naval architecture and optimized performance ship in the current and potential market for shipping in line with the evolution of political and economic Black Sea, Mediterranean Sea and the Sea North in order to achieve extraordinary results strategy that positively affects the economic performance and the competitive advantage.

The company's strategy river-sea navigation align to new technologies anti polluting

Due to technological evolution simultaneous with alarming evolution of a global warming, occurred and legislative environmental taxation. They have a major impact on shipping companies which in future given, are obliged to renew its fleet with clean ship, to refit assets owned, or pay taxes and countless prohibitions which lead to activity restriction and the company's eliminate from market shipping.

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THE STRATEGY OF A RIVER-SEA SHIPPING COMPANY ALIGN TO NEW TECHNOLOGIES ANTI POLLUTING

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ABSTRACT

Due to technological evolution while alarming global warming evolution occurred and legislative environmental taxation. They have a major impact on shipping companies which in the future are obliged to renew its fleet with clean ship was retrofitted assets owned, or pay taxes and countless prohibitions which lead to restricting activity and eliminate the company's market shipping

Keywords: *strategy, anti polluting strategies.*

1. INTRODUCTION

Earth, which is covered in 80% of seas and oceans and global economic development is based on the exchange of goods, shipping service is emerging as an important link in the chain of economic activities internationally. Naval and river transport and is part of the shipbuilding industry which is comprised of both ship and research, innovation, design, construction and environmental protection. The impact on quality of life shipbuilding industry is of major importance given that relocation goods necessary both domestic and industrial, is performed using naval transport. As known commodity flows are traditional, and are due to geographical position of each country evolves through foreign trade product promoting own resources. The general picture of shipping activity is to be confused with a permanent predictable, ships, depending on characteristics, comply with the same scanning routes, between industry and the consumer. The effects of globalization are felt in maritime transport activity in two distinct forms, namely:

- Movement of goods and raw materials is controlled and predictable of transport need is high with far fewer beneficiaries of transport but with consistent potential,
- Reducing the amount of freight because consumption monitoring and optimization of logistics in multinational companies (ex. cereals) drastically reduces of transport volumes and distances.

At the same time the industry has suffered many transformations so that maturing, is to resist the effects of globalization and the financial crisis, this, reconfiguring markets approach and international trade policies. This has resulted in profitable emerging industries (the developing countries) thus creating a pillar of macroeconomic growth and profitability support investment appetite into these areas infrastructure. Marine industry has expanded at a technical component impressive performance of the transport service and waterways, the result of research resulted in propulsion with minimum pollutant emissions being assimilated by adopting policies and protective marine environment.

2. METODOLOG

Considering qualitative research method optimal for the development strategy of the latest technologies genereatie which is distinguished by technical superiority leads to a drastic reduction in pollution and develop high efficiency that creates competitive advantage through quality transport and economic performance.

Industrial changes that lead to the reconfiguration of quantitative flows of goods with the contribution establishment of new routes with other perspectives that calls for the promotion of new types of ships to maximize service performance with lower risk and performance objectives of transport company.

The implemented strategies in order to bring efficiency in naval transport, special emphasis on mastering overall risk exposure and lead to different approaches to the shipbuilding branches industry. Ordering ships and equip them depending on future market needs in accordance with the rules applied on the environment is one of the vital points of a shipping company that wants to develop the strategy for development by revamping.

Considering the technical details and capabilities of transport, type, strength and speed cruise ship performance characteristics, they are relative to a criterion of economic performance that is represented in economy activity as a profitability indicator (KPI).

Ability to understand the mechanisms of economic and financial policy Supported transport activity, leads to the elaboration of performance strategies that, implemented and appropriately performance managed by assessing existing challenges, leading to remarkable achievements.

Strategy is defined as a basic matrix of the present and planned targets by using resources, interaction programs with the company and attention given market competition.

The target's strategy is performance on imposed criteria as the goal, developed a dynamic balance between the need for compliance and the need to maintain competitiveness in an economy suffering due to the effects of globalization, pursuing stability through competitive advantage.

The strategy will take into account of all potential whose opportunities may have positive effects in shipping activity development spectrum. Because we address shipping for proper market for bulk goods, we emphasize that, although lately, stock exchanges were no longer accessed due to the demand decrease, and the information leads to direct contact: buyer -seller, trading model of financial derivatives instrument (FFA contracts) in the maritime transport of dry bulk goods is increasingly protruding. The same trading method is also used for wet bulk goods (oil, derivate oil and liquid chemicals). On base of these elements of operational coordination to the operational river-naval transport ships, remain the understanding of market mechanisms. The essential factor of world trade is the demand and, viewed from ship-owner perspective, is vector control both commodity prices and freight rates according to potential fleet of ships which and adapts the type of goods.

Development strategy of companies sailing takes into account both the economic conditions of areas in which the ship is evolving but also the conditions offered by existing and potential market. Financial crisis are assessed as harmful activity of international trade and also, the shipping companies sailing to survive, had to give a series of vessels whose operating costs exceeded acceptable limits in order to sustain a profitable activity for a given unit of time; Thus decreasing the number of ships resulted in failure when reviving commercial relationships and thus increased freight exacting conditions imposed when demand was much smaller as such offer being made a qualitative leap in shipping.

Management of shipping companies have a high level of professionalism to face all odds that interferes activity by taking timely essential decisions to avoiding major losses. A leading position in strategies developing is occupied by an information management that takes from inside to putting outside all analysis to the market sensitivities, thus reducing the potential risk. Paradoxically, moments of crisis tend to increase such management discoveries.

Strategy development is characterized by a complex structure that objectively responds to business opportunities identify in geopolitical most bizarre conjuncture, offers a clear view of the policies applied to each problem in part, creates structures of information and operational control both internally and externally in order to minimize the risks that may occur throughout the duration of the contracts, create means for analyzing and intermediate evaluations, whose results lead to the efficient use of resources in view of creating competitive advantages. The strategy includes management programs in order to achieve coherence and communication in change management or critical situations that occur in shipping activity both from the effects of the economic mechanisms and meteorological origin as it unfolds in the hostile environment of human life.

The structure of the strategy is dictated by economic conditions and the evolutionary trend of the shipping market. The rules and policies are integrated in strategy that coordinates behavior in order to achieve the performance (price policy, the capacities, etc.). The main objective of the strategy is a service achievement that is required on the naval transport market by the superior quality that confers competitive advantage and as a behavioral feedback, technical and financial performance. From here there is a intestinal relationship between imposed conditions by the market, strategy, behavior and performance.

The characteristics of shipping bulk goods are found in:

- High fixed costs
- Small differences between the services offered,
- The high rate of concentration of companies in the areas of economic influence that which is translated to high competition in a market restricted punctual,
- Resistant commercial old links and the shipping company reluctance to change, which is due to a psychological comfort vis-a-vis the security and safety of goods. This is reflected in the difficulty of entering the market due a barrier by behavior created.

River transport companies are obliged to apply the principles of strategic management in the whole spectrum of organizational to support and control the activity throughout its duration, speculating all the opportunities arising in the market structure, with a complete view and constant on the evolution of the competitive behavior, to meet all problems which may occur in developing transport activity. Shipping companies have in their management strategy a control system information in order to achieve some strong links between partners from both outside and inside, organigram and management information creating an environment that maintains system: external information taken, sent.

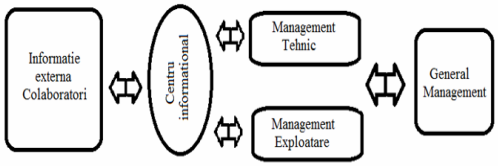


Figure 1 Management Strategy

To departmental management and then structured and analyzed to general management where decisions are taken, that back on the same path, in order to prevent hostile action and elimination of potential adverse effects. Firms whose business is shipping are forced to make quick decisions and accurate to support the work organizational and performance goals. General business strategy is reflected in the architecture of resource allocation methods that can manage crisis situations creating order to raise overall efficiency.

A strategy of shipping dry bulk is structured operational in:

- Operating segment, which refers to the company's strategic operational, industry type and quality of relational operational (liner shipping company in the contract or time charter boat rods with operating liabilities of goods by means dashboard etc.)
- Market segment (area of operation), and in our case there are exemplified Black Sea, Mediterranean

Sea, North Sea and Far East Market, more precisely, in China.

- Objectives - shipping companies are usually part of the strategy of development of a country whose booming economy. Objectives to be attained are supported by policies that stimulate the activity of shipping, that the high level of objective and nature of evolution, supports trade and stat economy. There are independent Companies who have contributed indirectly to economic development without being involved in the development strategies of different industries but are umbilical national policies related to infrastructure and environmental protection.

To achieve the objectives and performance, in shipping services resources are allocated whose spectrum cover the necessary to support safe activity. These resources are economic-financial, human resources and assets. These resources are found usually in fixed costs, but they can be supplemented, whenever you are requests or opportunities require this (most relevant example is the transport of ensemble or parts of large-sized (project cargo) whose boarding and mooring forces and request additional devices but of course that can be found in size and freight). In company strategies navigation are found also the potential opportunities are taken into account and prepared resorts for execution supplement service (ship line has established contracting parties a route and a time for achieving this if it is reconfigured it route and ports have the necessary infrastructure and cargo handling is done by means board resources are supplemented so that service small vehicles built to achieve the optimum conditions for both the owner and the beneficiary. the flexibility and proper management of resources makes the synergy these resources to perform during crisis reinforcing the positive features of all the resources.

Strategies aimed at achieving performance and waterways transport companies in transition or reorganization are characterized by:

- The company becomes the refurbishment of what is to be,
- Reconfiguring the business plan that is exceeded for various reasons in support of the proposed strategy and to determine objectives,
- Changing attitudes in order to improve operational processes and their relationship with external organizations.

Absolutely all valences strategies depend on market dynamics and transport performance is reflected in the organization of the production process, calibration and balancing of consumption in a real harmony with market needs. "Orientation" to develop shipping market activity can be defined as visionary assessment of market on acceptable terms, so that quality of service provided to be properly assessed as market needs, maximizing profit and KPI. To achieve the "orientation" or relationship with customers Focus navigation company structures are forced to become responsible, using available resources, by folding skillfully and profitably on the needs of beneficiary's transport and market dynamics. Customer orientation is defined as the concentration of all efforts and resources necessary to meet clients even if this is achieved by means of integrated services or economic alliances. A targeted company recognizes the importance of customers and potential its competitors; It is essential to perceive the threat competitive and competitive deficiencies in strategy for competitive advantage by introducing ways to counter threats and to strengthen weaknesses in both auspicious periods and in times of crisis.

In any company strategy that wants to perform market shipping, coordinating functions of interaction and communication departmental plan are found, in order to evaluate superior customer. Any feature either mandatory or voluntary that a customer requests it, but if introduced into service, increases customer satisfaction print quality of that service, creating competitive advantage and increase profitability margin. Companies that have an "orientation" proper market river-naval transport and know characteristic elements, strategically analyzed market that wants to be a player and analysis results are used in solving the equation that results in performance.

Strategy which aims competitive advantage and operational efficacy are factors which have aim to overcome the competitors and achievement of economic performance. Navigation behavior of companies is characterized by operational efficiency and competitive advantage using the strategy into practice together irrespective of their approach. Performing operational effectiveness factor can be defined as the difference in quality of two competitive situation similar activities in which make use of practices that allow shipping or river company to use its superior resources. Differences in efficiency may affect the profitability of directly influencing the estimate relative cost. Through a competitive operational management policy in benchmarking, performance transport service, can generate maximum impression quality by satisfying transport beneficiary in conditions of low risk with protection of the environment so that creates a superior return.

Competitive strategy in terms of a strategic positioning can be differently addressed. This underscores that the recipe of simple or integrated transport service that meets customer is a mixture that highlight the company that promotes this mix. Strategic positioning approach is characterized by different modes of similar activities that are conducted by other organizations in the shipping market. Positioning strategical have three behaviors as follows:

- Positioning by the type and quality of transport in accordance with the beneficiary's shipping needs, depending on the choice of the type of service given that the market offers alternative and requires quality of service required by the transport or transport integrated
- Positioning according to the needs are focusing on the needs of a group of customers with different needs for different types of transactions, so shipping companies have the right to opt for liner shipping or other type of format, in order to meet demand of this type request.
- Positioning depending on access potential, it refers to processes that are based on appropriate actions and qualitative approach to customer. Market segmentation is the process necessary analytical evaluation of existing customers, and potential customers of the trend. From

the standpoint of carriers of bulk cargoes dry in contracts time charter are different possible combinations associated to realize the number of vessels for committing Service shipping for lots of goods whose amount exceeds the company's potential while unable to refuse service.

The process of developing transport strategies can be defined as the sum of all activities and decisions promoted in designing and implementing transport strategies. Develop and implement a strategy management in river and transport involve assumption of interdependent decisions, responding to questions like: what to apply, how to approach and how to be applied. The objective and strategies are developed in the spirit of achieving immediate resources or capacity available but also potential shipping company that are in consent with the organization's strategic direction and targets.

Develop of a shipping strategy companies is based on the result of analyzes relevant factors with direct effects on activity either in quality as either in financial evolution. Strategic analysis is the first step in designing a strategy for shipping by evaluating and analyzing opportunities and threats arising from the competitive environment. In shipping goods are taken and data systems and trade flows of goods considering of distances and transport characteristics. Management of shipping companies is sensitive to the opportunities but also the effects of hostilities created to address of work done, both by the competitive environment and the marine environment.

Design strategies should represent a request that market supports, the competitive situation in fact but also the potential, capacity for change and flexibility in a services by completing reformulation or by performing integrated shipping. Strategies must dress ability evolutionary systems into offered conditions by markets, whose characteristics are different and are subject to various cultural concepts.

Configure to a strategy for shipping companies involve assimilation of the following issues:

- Correct evaluation of internal capacities of the company by the amount and type of resources that can be valorized by structural management strategies and policies;
- Assess the environmental context for business by correctly assess the political, economic and technological;
- Correct evaluation of the competitors, by respecting qualities and speculating shortcomings;
- Correct evaluation of transport demand into the market by needs, addressed to the existing customers, the potential beneficiaries, to an evolutionary trendy and to the potential shipping.

Structuring and company organizing to implement the strategy and process control navigation in the company must have an architecture that ensures an efficient productive activity. Performance transport services within a company seen sailing through the strategic structuring, characterizes the organization's resources consistent with informational and communicative structure, efforts to coordinate and control system. In special cases, when the transport service is an integrated service, or combination of two or more companies to transport a large consignment of merchandise, and are basically created and developed synergies, are also created informational channels interrelated structures that also claim performance. Control is considered as an element of major importance and for this are created systems and procedures to monitor the operational process of exploitation or considered both preventives errors and the ability to control all active system of the organization. Managerial strategic control management is quite difficult to deal obtained performance as result of adopted decisions and policies. Control system applied by clear procedures that can monitor the progress of each department activities revolute can correct certain shortfalls that may arise from various external causes in order to obtain maximum results even if the target is not reached. This process of evaluation and monitoring can also serve as a basis for market behavior.

Structural variants of shipping companies are created in order to achieve simple harmony departmental, flexible and easy to control with the possibility of expansion or correction operations that occur in the production process. Performance of transport quality and financial performance are also due of alternate opportunities speculation occurring in the market, that can be identified and subjected to transformation into profit, using departmental structures of the company that can take over, interpret, analyze and develop both in horizontally and vertically any alternative proposed by the market.

An organization is considered to have a sustainable organic growth, when evaluated, increased turnover and profit performance is achieved through work done (direct production), not financial speculation or association or company acquisitions. Organic growth is alternative culture that supports organizational culture and perfect control of shipping companies is applicable in all opportunities supported by market speculation of car correlated with enterprise resource potential.

Policies and development strategies and market repositioning shipping, can take various forms at macro level to departmental. They fallow the performance, speculating on market opportunities and various stratagems imposing of the competitors in the same market. Examples of such strategies are part and buying (taking over the majority) of listed companies whose insufficient resources potentially merged with the acquiring organization to turn into a real competitor in the market of transportation. The acquisition may have destructive connotations, with the aim of eliminating competition when conjuncture creates an opportunity situation. Joint ventures also called “strategic alliances” in performing a contract, are much used in practice describe a range of organizational structures uniting capacities assets and resources in order to achieve common objectives and not have destructive features because of merger or relationship. The strategic alliance shipping industry is driven by the need to achieve performance proposed by operational gains. Another structural form is the Joint Venture is a venture organization created due to the incentives that motivate partners to be able to access the market through appropriate change management unless a contractual

agreement. Creating strategic alliances lead and strengthen targeted objectives such as:

- In the category of financial goals: maximizing of profits while reducing financial risk;
- The category of economic objectives: cost reduction by operational savings realizing from optimization;
- In the category of strategic objectives: Gaining new markets or new customers by stabilizing competitive advantage;
- In the category of marketing objectives: satisfaction beneficiaries shipping or shipping integrated, by increasing the number of voyages and thus the amount of freight, diversifying routes and contractual relations.
- In the category of operational objectives: increasing rhythmic journeys, improvement of logistics systems, optimization of ship operation and interdepartmental operations.
- In the category of vessel operation objectives; adopting codes of protection of the marine environment and protecting the environment

Another approach to the strategy in the specific context of naval transports are also in the configuration of "Network" that which is a structure composed of resources and current organizations evolving in the spectrum and establishment support of facilities for the proper performance of integrated transport. The transformation process of a transportation network, as represented by contract line, through a creating process, can become an operational process. Building relationships between member organizations of the structure pursue that, through cooperation, to sustain an appropriate operational entourage that can properly perform by putting resources in operation. The network gives organizations structural benefits such as:

- The creation of flexible integrated carrier offer, maximum quality which aims, arising of attractiveness or creating competitive advantage;
- Improved integrated transport service by reconfiguring thus creating the contacts--legaturi other structures more or less distant or operational co-opted as a whole;
- Creating an attractive offer in terms of freight, which contribute to profit growth by increasing the amount operated.
- Reduce financial risk in case of a single or integrated transport service, also reducing capital investment and which should support its activity in integrity.
- Raising perception, opposite the ability of operation, transport quality, safe operation and environmental protection that lead to the credibility and compete to increase market share.

Although shipping involve a high complexity and market mechanisms global expose this activity to an effervescent high, attraction to this industry grow with its challenges, simultaneous with its taking risks, found in strategies and complicated economic architectures, placed in the opera by entrepreneurs charismatic.

3. RESEARCH RESULTS

In the economic activity, the main objective is performance, this cannot be achieved if applied strategy is inadequate or inappropriate. In evolutionary dynamics shipping prefigures a new era in which technology is used in view of environmental clean. Performance in terms of political and economic prospects of the current legislative having into account environmental protection, shall be governed by the ability of technology to reduce consumption, compared to the classic propel with the emissions elimination that affecting the environment, with the ability qualitative evolution that provide competitive advantages (competitive advantage has been studied and published by Kenichi Ohmae, in "the Mind of the Strategist", 1983).

Companies develops strategies to achieve the objectives through operational policies and procedures converging economic interests. Due to the economic climate effervescence and shipping market dynamics, strategies reconfiguration and tactical approach change of transport markets is considered to be a continuous process. Processes and procedures are classified as essentially managerial performance. In the shipping industry, an operational stage is completed, when the service is totally committed, and can quantify performants. The set of activities that aim to support and promote the process by realization of service that follows customer satisfaction and economic performance as the primary objectives of the company. (This chapter was studied and published by Hammer & Champy in "Business Reengineering" 1994 Kawalek Keung P. & P. In "The Goals in the Organization" at the International Conference BITWorld from Capetown, 30 June - 2 July 1999.)

Interrelationships between segments of the shipping industry, do the strategies to have character and approach, in harmony with other competing segments of the shipping industry and beyond.

The goal in a shipping companies subject study is upgrading or replacing the current fleet with a fleet of ships more efficient in terms dynamically, without emissions, whose increased capacity gives increasing service quality shipping and the possibility of repositioning in the market with achieving the desired financial performance.

Upgrading or replacing their vessels in a go-term stability is a very complicated process because it wants the ships to be met all possible nautical qualities that correspond to current needs and potential. Also aims, once to nautical performance raise, is desired lowering overall costs. Environmental protection is a key quality required by legislation passed and engine emissions standards and measures of avoid aquatic environment pollution.

In the concept of performance gains and profitability are found, only in consent with maintaining client's policies by servicing their clients depending on their needs and contexts (available at the right place, the right time and the right customer right vessel capacity).

The object is achieved by success you have achieved the quality of service ahead of the competition and thus establishing a clear competitive advantage while

respecting the timetable evolution vessels that will replace the old fleet.

Financial performance is measured by effectiveness and efficiency and is defined as the degree to which a predetermined objective (proposed following a previous analyzes) is made depending on the degree of production factors and used resources. (This indicator has been studied by Charles T. Horngren, George Foster. Published in "Cost accounting" 1987, p. 185-187). The measures that determine the company's financial performance alone are considered inappropriate in relation to all aspects of business.

4. CONCLUSIONS

The author of this article evientiat through the prism of qualitative research opportunity and implementation of clean technologies and economic performance in the current geopolitical context, bound for creating competitive advantage through appropriate strategies, profitability through quality transport service.

Current opportunities are evaluated in terms of creating a new development strategy that aims transition from a company with classical ships to a company with low pollutant emissions vessels, under the rules adopted by, maritime Codes, Laws, Rules and Directives such as:

The opportunity to work in two new markets that are found in economic areas with great potential such as:

- Market China whose economic interests of immediacy, accompanied by economic treaty "16 + 1" which refers to exchange of goods, freight and international relations of transport on the so-called "New Silk Road", which has positive effects throughout Eastern Europe, put in value infrastructure of 7 Pan-European transport channel, which is determined by the route followed by the Danube river, canal Maintz and Rhine River, which connects the North Sea with the Black Sea, drawing on the geostrategic position of Romania as riparian and gate to the Black Sea. Creating a belt of direct shipping between China and East European through naval infrastructure links.

Picture2 The initial proposal of the "New Silk Road"; Source: "The Diplomat Magasin"

- European economic recovery after the financial crisis is an opportunity that, speculated, can sustain sector development of fluvial navigation with qualitative leap of environmental protection adopted in the shipping sector.

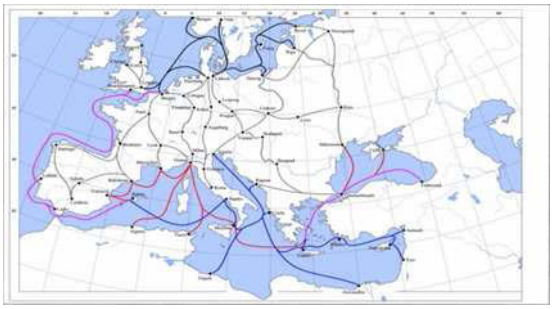
- Globalisation effect is also:

- This will require the ships equipment reconfiguration and creating of new structures, more advanced in rive- naval system and can make the performance difference.

Pictures 3 Strategic shipping route in Europe; Source: 7 Pan-European Channel,,

European strategy through the "DAHAR" (Integrated Strategy for Functional Specialization of the Danube Ports in the Logistic Chain) for development of this sector aligned to standards of environmental protection is another opportunity that will highlight the maritime and port infrastructure European fleets.

- Reopening of old trade ties interrupted in the Black Sea and the Mediterranean Sea by armed conflicts and political changes that took place in



Pictures 4 European naval trade routes.

South and South -East Mediterranean are about to be extinguished is another opportunity if viewed from the perspective of reconstruction of these countries and Europe is the first competitor interested in establishing trade relationships that lead to promoting the exchange of goods and strengthen shipping maritime.

Opportunity is introduced into the equation to evaluate from an operational perspective the qualities nautical of vessels that will replace the actual fleet, to correspond technically to the infrastructure areas of operation, having also the strength and configuration of on-board equipment to meet the flexible needs imposed by the expected objective.

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APPROACHES REGARDING THE HARMONIZATION OF EUROPEAN MARITIME UNIVERSITIES' CURRICULA

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ABSTRACT

The maritime industry is from long time a global one. The multinational crews are nowadays a reality and the only chance to obtain good results is to have common standards and practices in maritime training and education. The STCW Convention succeeded to assure a minimum standard and the last Manila changes made the requirements closer the market needs.

Even if the European Union adopted through a directive the maritime education and training standards a harmonization of practices among European countries, as well as with other future Member States is important. The MarEd Tempus project proved to be a good opportunity for such a purpose. The paper presents the background and the main goals of this project.

The actual high level of professional graduates need requires efforts in keeping the quality of maritime education at a high level, connected to the technological developments in the maritime industry.

Keywords: *Labor market, maritime education field, amendments, curricula.*

1. INTRODUCTION

Any specific activity of a particular industry needs employees able to meet the specific requirements of the employer and of the industry in general and in order to do this their education is the most important. When referring to the maritime field, the human factor is essential, because considering that the world's maritime traffic is very large, it is in most cases responsible for the accidents and disasters occurring at sea. This highlights the importance of education of seafarers, which should be seen as a product in which we need to invest in order to get the high level of quality. Even if their education depends from country to country, the quality of every officer should be as high as possible (Galić, et.al., 2012).

The education system of every maritime university needs to be harmonized with the European Union Standards; the seafarers have to be trained and educated in accordance with relevant international conventions, which have a major impact on the maritime industry. We need to point out that the European Union requires knowledge-based life-long learning for seafarers, a long-term process that should be well-planned in order to ensure high quality (Ćorović, et.al., 2012).

2. SUPPLY AND DEMAND FOR SEAFARERS ON EUROPEAN LABOR MARKET

The manpower demand is an essential element regarding the activity of European maritime universities and this is why the forecasts for the future manpower demand are very important. In order to obtain precise predictions on manpower demand we need to take into consideration that they depend mainly on assumptions about future world trade growth and also on the number of ships that can be used to transport it. Even if, over time, data showed that this forecasts rely on the world trade, we need to point out that nowadays there is a tendency which refers to the construction of ships with a larger carrying capacity without an increase in their crew.

So, according to the data revealed by UNCTAD[1] the global seaborne shipments have increased by 3.4% in 2014, as for the world fleet, there was an increase of over 3.5% in 2014 as a response to the growth in demand. Those figures highlight the need for more officers and ratings, needed to support the growth in trade and ships.

Since 1990, Baltic and International Maritime Council (BIMCO) and the International Shipping Federation (ISF), study the worldwide supply and demand for seafarers so that they can make prediction for the next period (5 years) in order to help the maritime industry face the upcoming developments. According to their latest (2010) study there is a shortage of educated and well-trained seafarers around the world on the labor market, the supply was estimated at around 624,000 officers and 747,000 ratings, while demand was of 637,000 officers and 747,000 ratings. The results of the study revealed that in 2010, the estimate number of seafarers was of 254,119 in maritime EU Member States and Norway, out of which 143,967 officers and 110,152 ratings[2]. Regarding the total workforce, the seafarers from the EU Member States and Norway represented, in 2010, over 18% (23% of the officers and near 15% of the ratings). The tables below show the distribution of officers and ratings in the most representative counties of European Union including Norway.

Table 1. The distribution of officers in the most representative counties of European Union including Norway

No.	COUNTRY	OFFICERS
1.	ROMANIA	18,575
2.	POLAND	17,923

[1] Data from "Review of maritime transport 2015"
[2] ISF/BIMCO Manpower up-date study 2010

3.	NORWAY	16,082
4.	UK	14,657
5.	BULGARIA	10,890
6.	GREECE	9,993
7.	ITALY	9,560
8.	SWEDEN	5,958
9.	LATVIA	5,509
10.	FRANCE	4,568
11.	GERMANY	3,997
12.	SPAIN	3,181
13.	NETHERLANDS	3,014
14.	FINLAND	3,000
15.	LITHUANIA	2,916

Source: ISF/BIMCO Manpower up-date study 2010

Table 2. The distribution of ratings in the most representative counties of European Union including Norway

No.	COUNTRY	RATINGS
1.	BULGARIA	22,379
2.	ITALY	11,390
3.	FRANCE	9,128
4.	UK	8,536
5.	NORWAY	7,300
6.	ESTONIA	6,300
7.	GERMANY	6,256
8.	ROMANIA	5,768
9.	SWEDEN	4,965
10.	POLAND	4,746
11.	SPAIN	3,862
12.	GREECE	2,970
13.	LITHUANIA	2,479
14.	LATVIA	2,383
15.	LUXEMBOURG	2,164

Source: ISF/BIMCO Manpower up-date study 2010

3. THE MANILA AMENDMENTS TO THE STCW CONVENTION AND CODE

In order to obtain quality in the maritime education field, the seafarers should be train and educate in accordance with the international conventions associated to maritime industry: STCW (Standards of Training and Certification and Watch keeping), SOLAS (Safety of Life at Sea) and many others.

Until 1978, the standards for training, certification and watchkeeping for seafarers were set by each government, individually, usually without reference to the practices from other countries, so they varied greatly, although the maritime industry is one of the most "international".

The minimum standards for training, certification and watchkeeping for seafarers have been agreed internationally level through the International Convention for Standards of Training, (STCW Convention) adopted in 1978 by a conference organized by International Maritime Organization that entered into force in 1984 and was significantly amended in 1995. Each country is required to meet these standards

The amendments to the Convention from 1995 actually represented a major revision of it. The new revised Convention entered into force in February 1997 and one of the main changes was the structuring of the technical annex by rules, divided into chapters and adding a Code in which they were transferred many of the technical rules. While the provisions of Part A of the Code are mandatory, the Part B - are as a recommendation. Generally speaking, the Convention contains the basic requirements, which are then detailed and explained in the Code.

The Manila amendments to the STCW Convention and Code were adopted on 25 June 2010, marking a major revision of the STCW Convention and Code. The 2010 amendments are set to enter into force on 1 January 2012 under the tacit acceptance procedure and are aimed at bringing the Convention and Code up to date with developments since they were initially adopted and to enable them to address issues that are anticipated to emerge in the foreseeable future.

The Manila amendments addresses to the critical areas caused by continuous analysis of shipping incidents, given that the human error is the basis of 80% in their entirety.

Amongst the amendments adopted, there are a number of important changes to each chapter of the Convention and Code, including:

- ✓ Improved measures to prevent fraudulent practices associated with certificates of competency and strengthen the evaluation process;
- ✓ Revised requirements on hours of work and rest and new requirements for the prevention of drug and alcohol abuse, as well as updated standards relating to medical fitness standards for seafarers;
- ✓ New certification requirements for able seafarers;
- ✓ New requirements relating to training in modern technology such as electronic charts and information systems (ECDIS);
- ✓ New requirements for marine environment awareness training and training in leadership and teamwork;
- ✓ New training and certification requirements for electro-technical officers and established new professional profile for the electro-technical officers (Regulation III/6);
- ✓ Updating of competence requirements for personnel serving on board all types of tankers, including new requirements for personnel serving on liquefied gas tankers;
- ✓ New requirements for security training, as well as provisions to ensure that seafarers are properly trained to cope if their ship comes under attack by pirates;
- ✓ Introduction of modern training methodology including distance learning and web-based learning;
- ✓ New training guidance for personnel serving on board ships operating in polar waters; and
- ✓ New training guidance for personnel operating Dynamic Positioning Systems.

Related to the Engine Department, there were changes related to the standards for training, certification.

Related to the mandatory minimum requirements for certification of officers in charge of an engineering watch in a manned engine-room, significant changes were included. The sea practice requirements were changed, thus:

- Every candidate for certification have completed combined workshop skill training and an approved seagoing service of not less than 12 months as part of an approved training programme which includes onboard training that meets the requirements of section AIII/1 of the STCW Code and is documented in an approved training record book, or otherwise have approved seagoing service of not less than 36 months;
- Every candidate have performed, during the required seagoing service, engine room watchkeeping duties under the supervision of the chief engineer officer or a qualified engineer officer for a period of not less than 6 months;

For marine engineering at the operational level, new competences were added or among the existed competences were included new knowledge, understanding and proficiency requirements:

- among the competence „Maintain a safe engineering watch" were added "Knowledge of engine room resource management principles";
- new competence: „Use internal communication systems" was included;
- among the competence „Operate main and auxiliary machinery and associated control systems" were included new knowledge related to "Basic construction and operation principles of machinery systems", "Safety and emergency procedures for operation of propulsion plant machinery, including control system", "Preparation, operation, fault detection and necessary measures to prevent damage for the machinery and control systems";
- among the operate pumping systems, were introduced also operate fuel, lubrication, ballast systems.

New training and certification requirements for electrical, electronic and control engineering at the operational level were included:

- operate electrical, electronic and control systems;
- maintenance and repair of electrical and electronic equipment;

The function related to the maintenance and repair at the operational level was changed:

- appropriate use of hand tools, machine tools and measuring instruments for fabrication and repair on board;
- maintenance and repair of shipboard machinery and equipment.

Among "Controlling the operation of the ship and care for persons on board at the operational level" function, the following competences were introduced: "Application of leadership and team working skills" and „Contribute to the safety of personnel and ship".

The Manila amendment contains also a regulation I/15: Transitional Provisions that refers to the transition period to the new changes. Thus, "until 1 January 2017, a Party may continue to issue, recognize and endorse certificates in accordance with the provisions of the Convention which applied immediately prior to 1 January 2012 in respect of those seafarers who commenced approved seagoing service, an approved education and training programme or an approved training course before 1 July 2013."

4. PROJECT REGARDING THE HARMONIZATION OF THE EUROPEAN MARITIME UNIVERSITIES' CURRICULA

In order to show that there are many concerns on the harmonization of the European maritime universities' curricula, on the behalf of the TEMPUS program, there was develop the MArED Project (Modernizing and harmonizing maritime education in Montenegro and Albania) in seven countries:

- Montenegro (as project coordinator represented by University of Montenegro and as partners represented by Minister of Education of Montenegro, Crnogorska Plovidba A.D. Kotor and others);
- Albania (as partners represented by University "Ismail Qemali" of Vlora, Shkodra University "Luigj Gurakugi" and others);
- Slovenia (as partner represented by University of Ljubljana);
- Spain (as partner represented by Technical University of Catalonia)
- Romania (as partner represented by Constanta Maritime University);
- Croatia (as partner represented by University of Split);
- Austria (as partner represented by Karl-Franzens-Universitat Graz).

Within this project the partners try to give assistance for the modernization and harmonization of maritime education in Montenegro and Albania. Some of the objective of this project concern:

- Revision of the existing and development of new undergraduate study programmes;
- Upgrading teaching materials and methodology, and(re) training of teaching staff;
- (Re)accreditation of undergraduate study programmes;
- Introduction of IMO model courses (LLL) for training of seafarers;
- Implementation of undergraduate study programmes and IMO model courses etc.

The MArED Project aims that through this program to enhance networking among higher education institutions across the Partner Countries, but also across the European Union Member States. The most important objective of the project is to develop the quality and relevance of higher education in the partner countries and also mutual understanding between partners and the other countries of the EU. It can also be taken as good practice for creating the necessary background for

mobility of students and professors. Both Albania and Montenegro search true this project to revise, develop and establish curricula and courses according to the requirements of IMO STCW Convention.

The goal of this project also includes the possibility of moving Albania on the White List.

5. CONCLUSIONS

The MarEd Tempus project is one of the success example of cooperation among European countries for exchanging good practices in higher education.

The maritime field offers a good background for such type of projects since the high level of curricula harmonization is required by industry as well as by relevant enforcing agencies.

Continuous update of the maritime knowledge according to technological development remained an important goal for all maritime education and training institutions.

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ANALYSIS REGARDING THE ECONOMIC BENEFITS OF INTERMODAL FREIGHT TRANSPORT

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ABSTRACT

In the context of globalization there is the common goal regarding the transport system which refers to its economical aspect. Intermodal freight transport is the one that allows a "door-to-door" transport, by the convenient use of vehicles, selected in order to achieve a much faster transport of goods at the lowest possible cost. The literature showed that there are many benefits related to this transport and through this paper it was attempted to emphasize the economic benefits of intermodal transport, due to the fact that those have a major contribution in increasing the performance of a transport chain. The final purpose of the paper is to transmit to the actors of the transport system the need for a change in the supply chain, which will definitely bring economic benefits to the whole transport of goods.

Keywords: *Transport system, intermodal transport unit, economic benefits, costs.*

1. INTRODUCTION

As any system that is working towards a common goal, the transport system takes into account the requirements of the parties involved, the elements that underlying their achievement (the transport modes, an adequate infrastructure, the equipment needed), but also the way in which they interact in order to achieve the predetermined final performance (Raicu, 2007).

There is an extensive literature regarding the connection between the economy and the transport activity, those two being closely connected; increasing performance in transport activity has led to sustain economic growth. The evolution of transport, especially the emergence of container transport (an essential part of intermodal transport), has led to an economic development of transportation systems worldwide, a development that was sustained by ports expansion, the appearance of specialized terminals and also by the increasing efficiency of vehicles. As showed in the picture below we can notice the relation between transportation and economy.

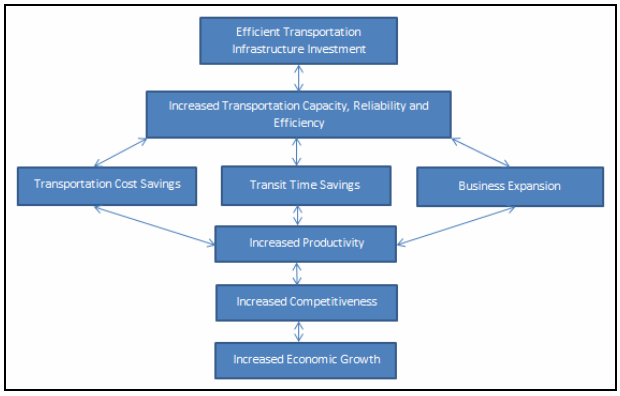

Figure 1 The relation between transportation and economy
Source: ICF Consulting (2002), Economic Effects of Transportation: The Freight Story

As was emphasized by the European Commission, the European Union has become one of the largest economies in the world, due to the development in former Soviet Union countries and to significant increases in imports and exports. The EU transportation system depends on the synergies that result from connections and integration of modes, but also on the efforts of key players in the public and private sectors.

According to the data revealed by Eurostat, in 2014, the modal split of goods transport in tonne kilometres for the EU-27 was 50.3% by road, 32.8% by sea, 12.3% by rail, 4.6% by inland waterways and 0.1% by air transport, the last two of them convers only intra-EU transport (EC/Eurostat, 2007). Analysing this data, seeing that rail and inland waterways have a relatively lower modal share, we need to point out their low contribution in intermodal transport. Despite this, we can easily notice the importance of transport within the logistic supply chain, regarding the distribution of goods.

Analysing the data provided by the Romanian National Institute of Statistics at the end of 2014, in Romania, the transport of goods increased over the same period of the previous year for all modes of transport, except road transport. Over 140,000 thousand tons were transported by road transport, almost 37,000 thousand tons by rail, 31,558 thousand tons by maritime transport (99.9% in the international transport), over 20,000 thousand tons by inland waterways, 23.6 thousand tons by air transport and over 4,700 thousand tons via main oil pipelines. In Romania there was an increase regarding the inland waterways transport of over 7%, while rail transport had a rise of almost 2%.

2. A SHORT PRESENTATION OF INTERMODAL TRANSPORT

Analysing the literature, there are many terms which are used as synonyms, even if they are relatively different (multimodal transport, combined transport and intermodal transport), but in our paper we will use the last one, defined as "the movement of goods in one and the same loading unit or vehicle that successively uses two or more modes of transport without handling the

goods themselves in changing modes" (UN/ECE, 2001, p.17).

The intermodal transport is considered to be a particular case of multimodal transport, which uses the ITU: intermodal transport units- container, swap body, trailers (UN/ECE, 2001, p. 43), as a mean of increasing the efficiency of the transport system, this is why intermodal transportation researches have recently increased; intermodal transport is considered to be the backbone of world trade (Bektas, T. and Crainic, T.B., 2007).

As there can be seen in the picture below there are many relationships between intermodal transport and other transport market segments, road freight transport being the segment which contributes most to the door-to-door services required by distribution and transport systems. When referring to sea, rail and inland waterway transport there is a need in decreasing the size of shipments, in order for the intermodal transport to obtain a share in transport sector of bulk goods, as with containerization was won an important share of general cargo traffic (Vrenken et. al., 2005).

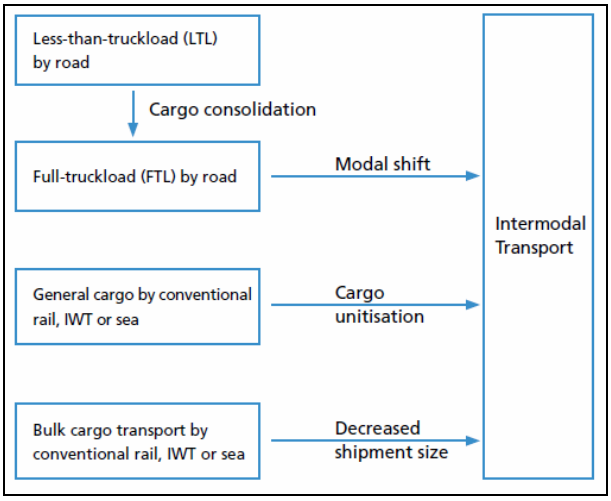

Figure 2 Intermodal transport and the freight segments closest to it
Source: Vrenken, H., Macharis, C. & Wolters, P. (2005), Intermodal transport in Europe, European Intermodal Association (EIA)

Studies have revealed that an intermodal system is defined both thru its points of connections and the links between them. There was introduced the need and accomplish of a "seamless transport" that allow the change in mode to be done as efficiently as possible without noticeable losses of time (Abbasi, M.F., 1996).

3. THE ECONOMIC BENEFITS ANALYSIS

Many studies have emphasized that the economy gains from the social and economic benefits intermodal transport, due to the fact that it allows obtaining integrated transport services at lower environmental costs.

A short analysis regarding the benefits of intermodal freight transport revealed many of them, all having a major contribution to the growth performance of a transport chain. When referring to intermodal transport system there are two important categories of costs: external and internal costs. Every type of costs appears in every stage of the intermodal transport, depending on several factors such as (Janic, M., 2007):

- The network in general: its location, the distances and the number of nodes;
- The efficiency of services;
- The prices of inputs;
- The number of activities related to every stage of the network.

Hanssen and Mathisen (2011) consider that the reduction of external costs is the main advantage of intermodal transport. Many studies were conducted to show that by combining the advantages of every mode of transport, usually replacing road transport with any other type of transport, entails a reduction in the value of external costs (congestion, air pollution, accidents or energy consumption).

Dragu (2009) emphasizes the social benefits of intermodal transport by improving working conditions for drivers, reducing the risk of accidents or congestion, especially by enhancing traffic safety.

When referring to the economic advantages the list is longer. The transport of intermodal transport units uses inland waterways, sea or rail instead of road transport leads to significant gains in terms of staff costs, maintenance and repair of vehicles or energy saving. Using at least two modes of transport reduces the final cost by combining the specific advantages of each mode used. In order to have an effective, efficient, and economical transportation system, the minimization of total transportation costs are required, due to the fact that they are an important selection criterion, when choosing the transport modes (Sahin et.al., 2014).

By measuring the economic benefits of intermodal transport, there was revealed the need for an investment in the logistical infrastructure, in order to support the growth of intermodal transport.

Table 1. Economic benefits of intermodal freight transport

Item no.	Primary impact	Associated direct benefits	Associated indirect benefits
1.	Modal shift, road to rail	Reduced transport cost (fuel consumption, maintenance and staffing costs)	Increased value of trade and GDP
2.	Increased direct investment (local economy)	Increased direct employment (number of jobs created)	Induced economic activity (through cluster development) and associated employment growth
3.	Reduced fuel consumption	Reduced CO2 and other atmospheric emissions and associated value	
4.	Reduced road traffic	Reduced road traffic accidents and associated costs	Reduced travel time (in urban areas) and associated

		Reduced road maintenance costs	saving

Source: United Nations ESCAP (2009), Policy Framework for the Development of Intermodal Interfaces as part of an Integrated Transport Network in Asia, 102 p.

Studies have shown that the economic benefits of intermodal transport begin to be effective while the transportation distance gets longer. On a certain distance the total cost of transport is lower for intermodal transport compared for example to the road transport (which has a smaller fixed component). For every transport there is a point in which the costs are equal (the lines intersect), as is presented in the picture below, point known as the break-even point. On a distance of less than 100 km the road transport cannot be beat, while over 500-600 km the intermodal transport represents a viable solution (Vrenken et. al., 2005). The comparative analysis between those two modes of transport revealed that intermodal transport brings much more economic benefits that a unimodal transport.

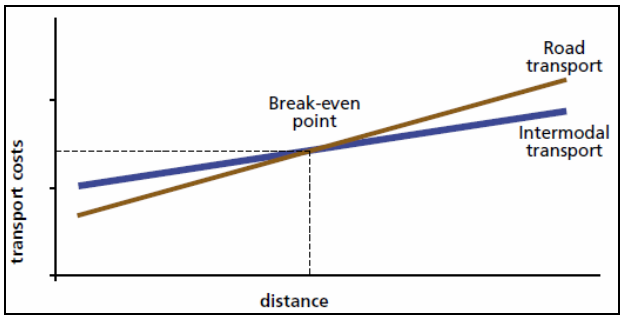

Figure 3. Road vs. intermodal transport in terms of transport costs
Source: Vrenken, H., Macharis, C. & Wolters, P. (2005), Intermodal transport in Europe, European Intermodal Association (EIA)

So, after this analysis, when we refer to the economic benefits of the intermodal freight transport we need to point out several conclusions (Yevdokimov, Y.V., 2000):

- It usually determine a reduction in the logistic costs (for the operations that are develop in every transport of goods) by introducing just-in-time distribution system;
- The expansion of the transport network fosters the development of the economies of scale;
- There is an increase regarding the volume of goods transported that can lead to economies of density usually achieved by cargo containerization and consolidation;
- It allows better accessibility for both input (specialized labour skills) and output (the opportunity to enter on broader markets) markets.

4. CONCLUSIONS

As was highlight Hanaoka and Regmi (2011) it is essential to promote intermodal transport, due to its economic advantages, but also to its environmental benefits. The intermodal transport requires the development of three important elements like: transport links (railway networks, highways or inland waterways), transport nodes (airports, ports or stations) and transport services, that always need to be taking into consideration.

The advantages obtained from fulfilling an intermodal transport are multiple, those having a major contribution in increasing the performance of a transport chain. It is important to note that in order to achieve these benefits, the most essential decisions refers to the selection of the intermodal transport unit, decision that that must take into account the type of cargo, the destination and the organization of the transport awarded. Such intermodal transport allows a seamless transport of goods from the point of dispatch to the destination.

This paper has reviewed the economic benefits of intermodal transport, which showed that:

- The intermodal transport is an attractive solution that needs to be considered when taking a logistical strategy;
- The benefits of intermodal transport begin to be effective while the transportation distance gets longer;
- The intermodal transport replies very well to the challenges of globalization and internationalization.

So, in order to achieve all the economic benefits of intermodal freight transport, there should be given a bigger importance on designing and development of intermodal development centres with the goal to ensure effective promotion and tailor made solutions to “intermodal users", with the general objective of improving the quality and the sustainability of freight transport.

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THE EVOLUTION OF CONTAINER TRANSPORT IN THE FRAMEWORK OF INTERMODAL TRANSPORT

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ABSTRACT

The importance of intermodal transport increased greatly during the last years on global level, the transporters searching always for the optimization of external costs, but also for the combination of the advantages related to each mean of transport, in an advantageous way. The container transport improved considerably especially in terms of the increasing capacity of the means of transport, but also through the construction of some performing means, which allow the efficient transport of the intermodal transport units (ITU). Through this paper, I have tried to present the evolution of the container transport both in terms of capacity and of construction of the means of transport.

Keywords: *Container transport, intermodal transport unit, containerships.*

1. INTRODUCTION

Taking into account the decreased transport capacity of road and rail transports and also their ill effects on the environment, the transporters' attention and, especially, the European Union's attention, was directed on the use of some combinations of means of transport, less pollutant and more safe (Leinbach, 2007).
As shown by the specialty literature, both the trade and the transport are in a close connection, because the efficient transport has as a goal a successful trade. In general, the international transport involves the use of some variable means of transport, each connection corresponding to a transfer, to a store keeping or to a transport operation which takes place in the country of origin, a transit country or in the final destination country. The development of the "door-to-door" transport imposed the development of the intermodal transport because of the fact that it allows the advantageous combination of the advantages related to each mean of transport (taking into account the increased transport capacity on the railway, the decreased costs of the sea transport, the flexibility of the road transport or the high speed of the air transport).

With the years 1960, it was introduced the concept of intermodality, like a quality indicator following the efficient integration of the means of transport on the level of the infrastructure, of the related operations, at the same time taking into account the regulation conditions. In this way appeared the notion of intermodal transport which presupposes the freight transport through an intermodal transport unit (ITU- container, mobile box or semi-trailer), using at least two different means of transport, without the splitting of the unit at the changing of the means, thus the goods not being manipulated, but only the transport unit. The introduction of the intermodal transport units represented a very important step for the international trade, causing changes both on the level of the means of transport and on the level of manipulation equipment and devices.

In order to minimize the negative effects of the globalization phenomenon, taking into view the cutting of transport costs, but also the cutting of external costs generated by the activity transport, it was considered that the intermodal transport represents one of the simplest examples of globalization which has in view one of its fundamental objectives: the long term sustainable development. Taking into account the globalization conditions, the realization of intermodal transport presupposes the existence of a corresponding infrastructure, able to allow the displacement of the means of transport under high performance conditions, the cutting of the parking time in certain points of the transport networks, but also the use of modern installations adapted for various categories of goods (Remes, 2011).

2. THE ROLE OF INTERMODAL TRANSPORT UNITS

As Raicu (2007) states in his book, the economic advantages of the intermodal transport units are multiple, both for the participants of the intermodal transport chain and for different economic sectors. The transport units determine the use of the means of transport for a longer period of time, as a result of the decrease of the duration of loading/unloading operations and trans-shipment from port, environment protection (through the reduction of packages traditionally used, which presupposes wood and paper), the introduction of some modern systems for the identification of the freight location (through the identification of intermodal transport units), but especially, and the most important, the realization of the "door-to-door" transport.

In Floden's paper (2007) are presented the three components of the general structure of the intermodal freight transport system:

- Freight collection and distribution system (a);
- Transport terminals (b);
- Transport system of flows of goods on long distances (c).

The figure below presents the development way of the activity realized within an intermodal transport system. All determinant elements of the intermodal transport system have the intermodal transport units at base. Nowadays, on European level, the most used

transport unit is represented by the container, which allows the easy freight transport along this system: in the freight collection and distribution system is used the road transport because of its flexibility, the transport of the flows of goods on long distances is realized using means of transport with a higher transport capacity than the road transport (railway, fluvial or sea transport). The role of transport terminals is to ensure the efficient transfer of containers from a modal transport system to another in maximum efficiency conditions.

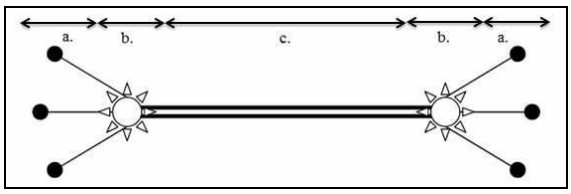

Figure 1 Basics elements of intermodal transport
Source: Flodén, J., *Modelling Intermodal Freight Transport- The Potential of Combined Transport in Sweden*, BAS Publishing, 2007

3. A SHORT ANALYSIS OF CONTAINER TRANSPORT

The freight transfer from a transport mean to another imposed modern transport technologies which use the transport units. In this way, besides the formation of packages (system used in order to obtain some packages which resist to the transport of various categories of goods, such as: logs, rolled steel etc.), appeared the pallet operation and the containerization (Raicu, 2007). The global market needs an integrated intermodal transport system, which offers the highest performance level at the transfer points (OECD, 2002). The containerization answered the best to the requirements regarding the efficiency of the freight transport, trans-shipment and manipulation operations.

In terms of the advantages offered (increased resistance, goods safety, high piling coefficient), the containers represent the most used intermodal transport units. The figure below presents the number of TEUs existing in the global fleet of port-container ships on the 1st of July 2014. In this way we can say that the container is at the base of the intermodal transport, this being the fundamental element which determined the development of intermodal transport, the largest part of the volume of transported goods which use the intermodal transport being realized through the containers (David and Stewart, 2008).

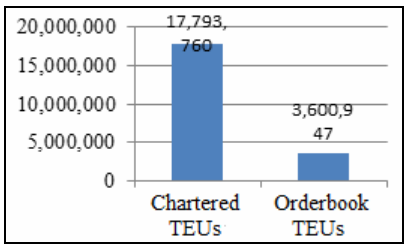

Figure 2 Number of TEUs chartered and orderbook
Source: www.statista.com

Regarding the structure of international seaborne trade, as shown by UNCTAD in the figure below, in 2014, the containerized trade (nearly 15%), has increased by over 5%, accounted for about two thirds of "other dry cargo" (general cargo and break bulk).

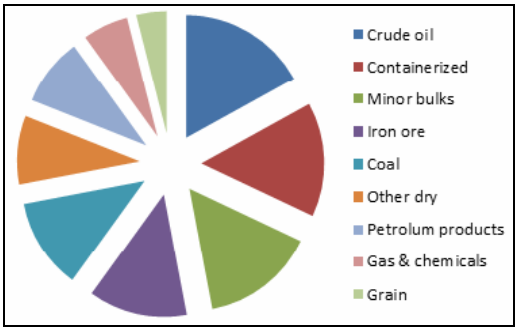

Figure 3 Structure of international seaborne trade, 2014
Source: UNCTAD, Review of Maritime Transport, 2015

As can be seen over the last years (1980-2014), the volume of goods transported in containers greatly increased which shows the importance of intermodal transport worldwide. The table 1 offers a general overview over the freight container transport regarding the millions of tones that were loaded.

Table 1. Freight container transport, selected years (millions of tons loaded)

Year	Millions of tons loaded
1980	102
1985	152
1990	234
1995	371
2000	598
2005	969
2010	1,280
2011	1,393
2012	1,464
2013	1,544
2014	1,631

Source: UNCTAD, Review of Maritime Transport, 2015

4. THE EVOLUTION OF CONTAINER TRANSPORT

As Vrenken, Macharis and Wolters (2005) pointed out, when we refer to the specific means of transport of the maritime and fluvial transport, it's important to remember that their evolution refers first of all to their transport capacity, but also to other important elements, such as:

- The existence of the means of manipulation aboard: these determine an increased cost of ships and a decreasing loading capacity, but at the same time it allows a higher flexibility level in the realization of loading/ unloading operations;
- Different designing of the space related to the storekeeping of the transport units;

- The country where the ships are registered;
- The ships class, etc.

The apparition of the transport units (especially the container's apparition) represented an innovation of the transport sector, ensuring the development of the international trade through the evolution of the means of transport, but also of the specialized ports or terminals (Vrenken, 2011). Either we refer to the ships used for the maritime of fluvial transport or to the railway trucks or means used for the transport of containers, semi-trucks or mobile boxes, all these suffered changes which allow them both the correct loading of the units and their safety transport.

The container determined the construction of some specialized means of transport, whether we refer to the road, railway, maritime or fluvial transport (ECMT, 2005) or not. For example, the apparition of the cooling container determined the construction of some specialized means of transport allowing its connection to the cold air feed for the entire duration of the transport.

If first port-container ships appeared under the form of some conversions of other types of ships, especially of tanks, gradually these evaluated from the point of view of the transport speed (existing projects which follow the realization of some fast ships, crossing the Atlantic Ocean in three days and half), but especially from the point of view of the loading capacity, in searching the realization of the size economics. The specialty studies show that it is followed the construction of some port-container ships of largest sizes, which transport a maximum number of containers, taking into account, at the same time, the restrictions from ports, but also the restrictions imposed by the transit of certain channels (David and Stewart, 2008).

As you can see in the figure below, the size of containerships has grown very fast over the last decade, and taking into consideration the ship orders that have been made, their size is expected to grow over the next years. Shipping lines as CMA CGM, MOL or OOCL have orders containerships with over 20,000 TEU capacity, with micro-optimisation in new ship design (Merk, O., et.al., 2015).

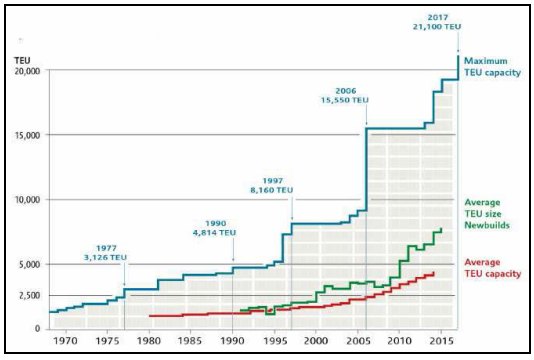

Figure 4 The evolution of container ship size
Source: Merk, O., Busquet, B. si Aronietis, R., *The Impact of Mega-Ships, International Transport Forum*, Report part of the OECD/ITF Mega-Ship project, 2005

Currently in operation there are many types of container ships, taking into consideration their design and construction, but also the type of goods that they transport (Institute of Chartered Shipbrokers, 2013). The most important types of container ships are:

a) Cellular container ships
b) Hatchless container ship
c) Feeder container ship
d) Semi-container ships

As regarding the world container fleet, nowadays containership vessels ranks third worldwide after dry bulk vessels and oil tankers; the container ship fleet increased by 5.2% in 2015 from last year[1], despite the continued economic crisis, summing 227,741 thousands of dwt.

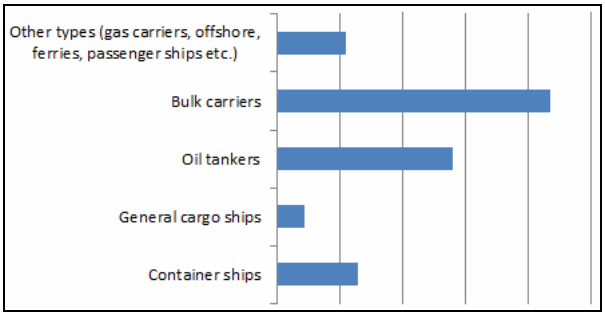

Figure 5 World fleet by principal vessel types in 2015
Source: UNCTAD, Review of Maritime Transport, 2015

5. CONCLUSIONS

The importance of goods transport registered a significant increase over time, the means of transport following a continuous improvement and modernization, taking into account the technique development, but also the constitution way of the transportation charges. The increasing volume of the transported goods, corroborated with the apparition of transport units, determined the development of some modern means of transport and manipulation technologies, allowing an easy transshipment of transport units.

The development of intermodal transport, as an essential element of the global trade, determined an increasing efficiency for the entire transport process, which involved the need to introduce some performing means. The specific means of transport of the maritime transport were developed much more once with the apparition of containers, compared to the railway or road transport, which had an evolution much simpler and less brusque.

As shown in this paper, the containerized transport was spectacularly developed over time, fact which demonstrates its importance and the major role it has within the international maritime transport.

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